STUDY OF ATMOSPHERIC EMISSION TRADING PROGRAMS IN THE UNITED STATES

- FINAL REPORT -

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I. INTRODUCTION

BACKGROUND

In November 1990, the Canadian Council of Ministers of the Environment (CCME) adopted Phase I of a Management Plan for the control of nitrogen oxides (NO_x) and volatile organic compounds (VOCs). The NO_x/VOC Management Plan addresses two primary objectives:

- To solve domestic NO_x-related and VOC-related environmental problems
- To meet Canada's international obligations for NO_x and VOC control

The plan focuses on the reduction of ground-level ozone. Ozone is formed in the atmosphere through chemical reactions involving NO_x and VOCs. These reactions require sunlight and appropriate temperature conditions. Although ozone and its precursor pollutants can be transported long distances in the atmosphere, health concerns due to high ozone concentrations are most serious in the Lower Fraser Valley, the Windsor-Québec corridor and the Saint John area.

Phase I of the Management Plan contains a base set of 31 specific emission-reduction initiatives for the national prevention program and an illustrative set of 27 regional emission-reduction initiatives that responsible jurisdictions may use in nonattainment areas. By the year 2005, the adoption of the initiatives will have reduced national NO_x and VOC emissions by 11% and 15%, respectively, compared to their 1985 levels. In key ozone problem areas like the Lower Fraser Valley, the Management Plan initiatives are designed to achieve reductions of 25% to 40%.

The estimated compliance costs of the measures proposed in the NO_x/VOC Management Plan in 1989 dollars are $415 million for NO_x control and $441 million for VOC control in the year 2005. Some of the participants in the consultation process requested an examination of emissions trading as a means of achieving the NO_x and VOC reduction targets at a lower cost. The Management Plan recommends that a study be conducted to evaluate the merits of NO_x/VOC emission trading for ozone control. One of the objectives of this study is to fulfill that part of the NO_x/VOC Management Plan.

OBJECTIVES

This study has two overriding objectives:

- To conduct a detailed review and evaluation of federal and state atmospheric emission trading programs in the United States to identify the factors critical to a successful program; and
- To make a preliminary assessment of whether an emission trading program for NO_x and VOCs could be successfully implemented in the Lower Fraser Valley.

To achieve these objectives, the study identifies and pursues five tasks:

- It reviews and evaluates the rules of federal and state atmospheric emission trading programs;
- It identifies the factors critical to successful implementation of an emission trading program;
- It compares trading activity under each program and provides (where possible) estimates of the cost savings achieved;
- It identifies measures necessary to evaluate the effectiveness of emission trading programs; and
- It makes a preliminary assessment of whether an emission trading program for NO_x and VOCs could be successfully implemented in the Lower Fraser Valley.

ATMOSPHERIC EMISSIONS TRADING IN THE UNITED STATES

To date, the experience of the United States with atmospheric emissions trading has primarily involved trades of **emission reduction credits** pursuant to the 1977

Clean Air Act amendments. Trades are generally triggered by large new sources of atmospheric emissions or expansions of existing sources in areas that do not meet the ambient air quality standards for NO_x, SO_x (sulphur oxides), TSP (total suspended particulates), CO (carbon monoxide), lead, or ozone.[1] The 1990 Clean Air Act amendments set limits on total allowable emissions of SO_2 (sulphur dioxide) by electric utility generating stations. The amendments include provisions for **tradeable allowances** to reduce the cost of meeting the limits on SO_2 emissions. The detailed rules governing trades of SO_2 allowances are still being drafted, so no trades have yet taken place. Although there will be similarities between the trading of emission reduction credits and the trading of SO_2 allowances, there will also be important differences between the two approaches.[2]

Emission Reduction Credit Trading

The 1977 Clean Air Act amendments require each area of the United States to attain ambient air quality standards for NO_x, SO_x, TSP, CO and hydrocarbons. To attain the standards, the act specifies a variety of control technologies for existing, modified and new sources of emissions. The stringency of the control technologies and the minimum size of regulated sources depend on whether an area has attained the legal standards. The principal means of improving air quality in nonattainment areas is through traditional command-and-control regulations.

A variety of trading mechanisms—offsets, netting, bubbles, and banking—have been developed, primarily to accommodate economic growth but also to reduce costs and facilitate compliance. Offsets allow a new or modified source to operate in a nonattainment area by purchasing emission reduction credits from existing sources in the same area. The new or expanded source must implement the specified control technologies and other measures to reduce emissions. Then it must purchase emission reduction credits to offset any remaining emissions. The objective is to accommodate economic growth while protecting air quality in the region.[3]

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[1] A National Ambient Air Quality Standard for hydrocarbons (which includes VOCs) existed prior to 1983, when it was revoked after it was determined that hydrocarbons would be controlled as part of the ozone control strategy.

[2] A system of tradeable allowances is currently in place in the United States for ozone depleting gases (see Chapter II). Its purpose is to reduce the cost of phasing out the use of these gases as required by the Montreal Protocol. A tradeable allowance system was also used to reduce the cost of lowering the lead content of gasoline in the United States (see Chapter II).

Netting allows expansion of an existing plant without triggering the stringent new-source review process. An expansion of an existing source that increases emissions beyond the specified minimum threshold is subject to the new-source review process. Netting allows emissions reductions achieved elsewhere in the plant to offset the increased emissions due to the expansion. If the net increase in emissions can be kept under the threshold level, the plant is not subject to the new-source review process. Netting trades are intrafirm trades.

Bubbles involve trades between existing sources to help the purchaser meet an emissions limitation. Unlike netting, a bubble does not involve a modification or expansion. Bubbles are usually intrafirm trades involving a single plant, but interfirm trades involving noncontiguous sites are also possible. Banking allows existing sources to store emission reduction credits for sale or future use.

Environmental Protection Agency policy, federal regulations and a number of state and local regulations determine emission trading rules. Most states rely on the federal emission trading rules, but a significant number have their own rules. In California, several air quality management districts have their own rules. Altogether about 30 different sets of emission trading rules are in force in the United States.

Hydrocarbons are the most frequently traded pollutant. Most trades occur under the netting provisions. Netting and most bubbles are intrafirm transfers, so prices are not available for such trades. The largest volume of trades has taken place in California, but trades have occurred in at least six other states. It is important to appreciate that the emission reduction credit trading programs are components of a larger air quality program. The overall program is intended to achieve specified air quality standards through command-and-control regulations. The emission reduction credit trading programs facilitate compliance and accommodate economic growth while ensuring that there is no deterioration of air quality. Although some of the current provisions of the emissions reduction credit trading programs contribute to improved air quality, their original purpose was to make compliance more flexible and cheaper while maintaining air quality.

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[3] New sources are often required to purchase more emission reduction credits than their permitted emissions (e.g., credits equal to 120% of permitted emissions). This requirement is a means of protecting air quality, not a means of bringing the area into attainment.

SO_2 Allowance Trading

The 1990 Clean Air Act amendments include provisions to reduce annual SO_2 emissions to 8.9 million tons by 2005 and to maintain them at that level thereafter. This requires a reduction in SO_2 emissions of approximately 10 million tons annually. These reductions are primarily expected to come from coal-fired electric generating stations. To lower the cost of achieving the mandated reductions in SO_2 emissions, tradeable SO_2 allowances have been created.[4] Each regulated source will receive allowances equal to its *permitted* SO_2 emissions on an annual basis. Each source must provide the EPA with allowances equal to its *actual* SO_2 emissions during the year.

Affected sources, primarily coal-fired electric generating stations, can switch to low-sulphur coal, install flue gas desulphurization systems or implement other measures to reduce their SO_2 emissions. If their actual SO_2 emissions are less than their permitted emissions, the surplus allowances can be banked or sold to other sources whose actual emissions still exceed their permitted levels. Thus, overall emissions of SO_2 are constrained to target levels, but individual sources have the flexibility to adopt the measures best suited to their circumstances.

The regulations governing SO_2 allowances are currently being written. The tradeable allowances are intended to facilitate reductions in total SO_2 emissions and the regulations will be written to reflect this intention. This objective is quite different from that of maintaining air quality, which underlies the trading of emission reduction credits. Although many of the trading rules are independent of the purpose of the program, others clearly vary with the environmental objective.

A tradeable allowance program for ozone depleting gases is currently operating in the United States. A tradeable allowance program was also successfully used to help implement a reduction in the lead content of gasoline. These two programs, which are discussed in the next chapter, constitute the actual experience with tradeable allowance programs. In addition to the SO_2 allowance trading program, which is currently being implemented, some states have considered programs that would use tradeable emission permits to facilitate reductions in atmospheric emissions. None of those proposed programs has yet been implemented.

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[4] It can be argued that since trading makes it easier and cheaper to reach the emissions reduction target, it was probably easier to get agreement on the rather stringent 10 million ton reduction. With the higher costs associated with a command-and-control approach, the target reduction might well have been smaller.

Selection of United States Case Studies

In consultation with the Steering Committee, six case studies of emissions trading were selected. The six case studies are:

- South Coast Air Quality Management District
- San Joaquin County Air Pollution Control District
- Bay Area Air Quality Management District
- New Jersey
- Jefferson County, Kentucky
- SO_2 allowance trading

Five of the case studies cover jurisdictions that have established emission reduction credit trading programs. The sixth is the national SO_2 allowance trading program currently being implemented.

This study uses observations about the design and accomplishments of these programs to assess the feasibility of NO_x/VOC trading in the Lower Fraser Valley.

II. THE U.S. FEDERAL EMISSIONS TRADING EXPERIENCE

Initially, emissions trading developed in the United States as a complement to traditional "command-and-control" regulation. More recently, it has served as an alternative to this type of regulation. The initial experience with emissions trading took the form of emission reduction credits. Trading of emission reduction credits is part of a program to achieve ambient air quality standards through command-and-control regulations. The emission reduction credit trading programs facilitate compliance and accommodate economic growth while preventing deterioration of air quality. In this way, they complement command-and-control regulations. However, the trading of lead and chlorofluorocarbon (CFC) allowances, together with the future trading of SO_2 allowances, is an alternative to command-and-control regulation as means of achieving a specified environmental objective. Emissions trading has met with varying degrees of success, and both the successes and the failures offer insights for the future design of more effective programs.

COMMAND AND CONTROL VERSUS ECONOMIC INCENTIVES

Until 1976, all American environmental regulatory programs were based on what has been pejoratively referred to as a "command-and-control" approach. Command-and-control regulation, broadly defined, is a process through which a political authority directs private entities to take (or not to take) specified actions or to engage in (or not to engage in) specified types of behavior. In this system, government enforces directives through standards, limitations and penalties.

In recent years, there has been some movement away from pure command and control in favor of incorporating market incentives into the regulatory framework. With market incentives, government's role is to set fees or taxes or to create marketable commodities as incentives for regulated entities to engage in certain types of behavior. A command-and-control approach might require installation of a specified control technology for regulated sources of an air pollutant, whereas a market-based approach might impose a fee on the amount of the pollutant emitted. If the fees are high enough, it will be cheaper to install the control technology than to pay the emissions fees. However, the firm may also be able to find ways of reducing its emissions that are even cheaper than installing the control technology. Under the market-based approach, the firm would be able to pursue the cheaper solution, but it might not be permitted to do so by the command-and-control regulators.

In the case of air quality, the "marketable commodities" approach has been used. In such a system, regulated entities have the option of reducing their own emissions to achieve regulatory compliance or buying the "right" to produce more emissions from an entity that finds it more economical to reduce its emissions by more than the required amount. Through "emission trading" of this sort, environmental protection or improvement is theoretically accomplished in the most efficient way possible.

THE CLEAN AIR ACT

Emissions trading experience has occurred predominantly under the authority of the Clean Air Act. The federal Clean Air Act (CAA) governs the release of emissions into the air in the United States. Under the CAA, the administrator of the Environmental Protection Agency (EPA) establishes the concentrations of designated pollutants that may endanger public health or welfare. These concentrations are called National Ambient Air Quality Standards (NAAQS). The EPA has issued NAAQS for six pollutants: particulate matter, sulfur oxides, carbon monoxide, lead, nitrogen oxides, and ozone. All areas of the country have been designated as either attainment areas ("clean air areas," where the NAAQS are met) or nonattainment areas ("dirty air areas," where the NAAQS are exceeded).

Since its passage, the Clean Air Act has been amended several times. There were major revisions in 1970 and 1977. The most recent revisions occurred in November 1990. Under the amended Clean Air Act, Title I addresses nonattainment problems, Title II addresses mobile sources, Title III addresses air toxics, Title IV addresses acid deposition, and Title V addresses permitting. A brief summary of the Clean Air Act provisions that are relevant to emissions trading follows.

State Implementation Plans (SIPs): Attaining and Maintaining the NAAQS

The Clean Air Act imposes a federal approach to the attainment of ambient air quality standards. The statute establishes broad guidelines and the EPA develops the implementation regulations. The states are then required to develop regulations in accordance with federal guidelines.

The regulatory programs that the states (and, in turn, the local air districts) adopt must ensure that attainment areas remain "clean" and that nonattainment areas achieve attainment. States are required to develop and carry out State Implementation Plans, or SIPs. In its SIP, a state outlines its strategy for attaining and maintaining the NAAQS and describes how it will implement federal rules locally. The SIP sets emission limitations for certain source categories and timetables for stationary sources to comply with regulations. The state uses reductions from existing sources to reduce emissions of pollutants enough to bring ambient concentrations below the NAAQS.

The Clean Air Act assigns the states deadlines for adopting SIPs and attaining the NAAQS. Because many states have been unable to meet their deadlines, Congress has amended the Clean Air Act to include several extensions. In theory, if an area fails to achieve a NAAQS by the specified deadline, the EPA can impose sanctions against the area. The most threatening sanction is a ban on construction of major new sources of air emissions. The EPA imposed such a moratorium on all nonattainment areas in the country in 1979 and on selected areas in August of 1988. New deadlines have been imposed under the 1990 amendments.

New Source Regulations

Under the Clean Air Act, different regulations apply to the review of new sources and expansions of existing sources whose emissions will exceed minimum threshold levels. Different regulations also apply to attainment and nonattainment areas. These regulations have a significant impact on the kinds of trading that can occur. Table II-1 presents a comparison of attainment/nonattainment and new-source/existing-source requirements.

Table II-1
GOALS AND REQUIREMENTS OF NEW AND EXISTING SOURCE REGULATORY PROGRAMS IN ATTAINMENT AND NONATTAINMENT AREAS

	Attainment Area	**Nonattainment Area**
New and expanding sources	Goal: *Prevent significant deterioration* ▪ Best available control technology (BACT) ▪ Air quality analysis ▪ Cannot exceed increments ▪ Netting allowed	Goal: *Cannot interfere with attainment efforts* ▪ Lowest achievable emissions rate (LAER) ▪ Offsets ▪ State-wide compliance ▪ Netting allowed in some areas
Existing sources	Goal: *Maintain air quality standards* ▪ Minimum level of pollution control ▪ Bubbling permitted	Goal: *Attain air quality standards* ▪ Reasonably affordable control technology (RACT) ▪ Emission reductions from existing sources ▪ Bubbles allowed but difficult to implement

In attainment areas, the goal of the Clean Air Act is the "prevention of significant deterioration" of air quality. To achieve this goal, SIPs establish air quality "increments" that cannot be exceeded. These increments serve as a safe buffer between existing air quality and the NAAQS. Within the limits described in the relevant SIP, areas that are in attainment can allow industrial expansion as long as the increments are not exceeded. The effect of these regulations on industry is that industrial development is relatively less complex in attainment areas even though preconstruction review requirements and technology standards impose strict and costly emissions limits.

The Clean Air Act goal for nonattainment areas is to improve local air quality so that it will comply with NAAQS standards by a prescribed deadline. Because nonattainment areas already exceed at least one NAAQS, further industrial development, unless strictly controlled, makes attaining this goal increasingly difficult. Not surprisingly, therefore, the regulation of industrial development is more strict and complex in nonattainment areas. Under nonattainment regulations, major new emissions sources (those expected to emit more than a prescribed threshold of designated pollutants) are prohibited unless (1) the SIP meets the requirements of the Clean Air Act, (2) the permit applicant meets the most stringent control requirements (lowest achievable emission rate [LAER]), (3) the permit applicant ensures that other sources owned by the applicant in the state are in compliance, and (4) the permit applicant more than offsets its new emissions with reductions from existing sources in the area, such that some increment of air quality improvement occurs.

EMISSIONS REDUCTION CREDIT TRADING UNDER THE CLEAN AIR ACT

Emissions Trading

In 1976, the EPA adopted its offset policy. The offset policy allowed new sources to site in areas that were in nonattainment of federal standards only if they obtained emissions reductions credits from another regulated entity. This was the first in a series of policies that later became known as "emissions trading."[5]

Emissions trading comprises five basic elements, which are as follows:

1. **Emissions Reduction Credits**. An emission reduction credit, or ERC, is any emission reduction that meets certain criteria established by the EPA. ERCs must be "real," "surplus," "quantifiable," "enforceable" and "permanent" before they can be certified by the relevant regulatory authority.[6] ERCs are the basic currency of emissions trading.

2. **Netting.** Netting allows a firm to avoid a particular group of regulatory requirements by balancing expected emission increases at one facility with emissions decreases at the same facility. Thus, the "net" emission increase is insignificant and specific regulatory requirements are not triggered.

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[5] Reinier Lock and Dennis P. Harkawik, eds., *The Clean Air Act: Compliance and Opportunity* (Public Utilities Reports Incorporated, 1991), p. 76.

[6] Before an emission reduction is approved, it must be demonstrated that the reduction is incremental to that forecast under the State Implementation Plan.

3. **Offsets**. In areas that fail to meet ambient air quality standards, firms constructing major emission sources or major modifications must offset the expected emission increases by purchasing emission reduction credits from existing sources that are at least equal to the expected increase.

4. **Bubbles**. Bubbles provide compliance flexibility to existing sources that are not being modified but must nonetheless reduce emissions. Using a bubble, a plant manager can make emissions control decisions in aggregate for all sources covered by the imaginary bubble rather than on a source-by-source basis. Bubbles allow firms to minimize compliance costs. Most bubbles cover a single plant, but they can apply to multiple facilities with the same or different owners.

5. **Banking**. Emissions banking policies give firms a legal means to store surplus emissions reductions for later use.

Emissions trading consists of voluntary and mandatory programs. In both attainment and nonattainment areas, firms can use emissions banking as a means to certify and store emission credits. However, it should be noted that all emissions trading alternatives except offsetting are voluntary. Offsetting is required for all new sources and major modifications in nonattainment areas. Therefore, as the definition of the minimum threshold for "new sources" or "major modification" becomes more stringent, more firms will be caught in the offset regulatory net.

Emission Reduction Credits Defined

ERCs are the common currency of emissions trading. To participate in any emissions trading alternative, an entity must either create ERCs or acquire them on the open market. ERCs are created when a firm controls its emissions to a greater degree than the law requires. There are several ways to create ERCs: by changing process inputs (or switching fuels), by instituting process changes, by installing pollution control technology, by curtailing production, or by shutting down an emissions source.

An emissions reduction must meet the following criteria to be classified as an ERC:

- ***Permanent.*** The emissions reduction must be permanent. Permanence is relatively easier to demonstrate for shutdowns and installations of pollution control technology than for switching inputs or production curtailments.

- ***Surplus.*** The reductions must be the result of an actual decrease in emissions and must not be necessitated by any other requirement in the applicable SIP. "Paper" reductions are not certifiable: if a facility has historically emitted at a rate lower than its allowable limit, it cannot claim the difference between the allowable and actual emissions as a certifiable reduction.

- ***Enforceable.*** The reduction and its method of creation must be legally binding and enforceable by the local regulator and, in some instances, by the EPA.

- ***Quantifiable.*** The reduction must be able to be quantified or measured.

Certifying emission reductions as ERCs requires considerable interaction with regional regulators. By nature, this interaction is an interdisciplinary process, requiring input from engineers, lawyers and often financial planners.

Netting

Under netting regulations, an entity may use emission reductions achieved at a permitted facility to avoid some of the preconstruction review requirements that would normally apply to a proposed major modification at that same facility. Under netting provisions, emission reductions created over a specified time frame can be balanced against the emission increases expected from the modification. If the net emission increase is below the regulatory threshold, the modification can be exempted from certain new-source review requirements.

In most regions of the country, netting allows a company planning a major modification to avoid the cost of control equipment, the acquisition of ERCs from outside sources, and the delay of preconstruction review. In regions governed by slow-moving regulatory bureaucracies, netting can mean a significant savings. Consequently, most firms feel a strong incentive to use netting to avoid new-source review requirements. In the past ten years, thousands of netting transactions have occurred. Netting has been the most common type of emissions trade.

Federal and state regulations restrict the use of ERCs in netting transactions to sources on the same or contiguous property. Typically, fuel switch, retrofit and shutdown-created emission reductions can be used for netting purposes. A netting "trade" is internal to the firm—the firm is both the buyer and the seller—so there are no price data for these trades. In netting transactions, increased emissions due to a source modification are offset with reductions at other sources on the same site so that the net increase is less than the minimum threshold.

Offsets

Offset transactions are required for many companies wishing to build or expand their operations in nonattainment areas. A firm planning a new facility that will emit more than the local threshold level of a nonattainment pollutant must acquire ERCs for that pollutant from other permitted sources in the relevant air shed. Although industrial managers complain that obtaining the needed offsets can be exceedingly time-consuming and expensive, the offsetting policy does provide a means for industrial development in areas where industry growth would otherwise violate Clean Air Act provisions.

State and local air pollution control agencies monitor offsetting in nonattainment areas. The EPA retains an oversight role and reviews offset transactions but plays a minor and often silent role in permit approval. Some air districts allow for a limited amount of new industrial siting under a "growth allowance" provision in their SIPs; however, most new major emission sources require offsets.

Generally, offset rules require that a new or expanding emission source secure more than enough ERCs to compensate for the planned emission increase (i.e., the "offset ratio" of ERCs to planned emissions must be greater than 1:1). The farther away the new source is from the ERC provider, the greater the offset ratio tends to be. Offset ratios vary widely from state to state and from pollutant to pollutant. In general, offset ratios range from 1.1:1 to 8:1. When offset ratios are greater than 1:1, each offset trade results in a net air quality benefit.

Regulations tend to be more restrictive about the types of ERCs that can be used for offsetting than they are for netting. In general, ERCs that result from process changes, including fuel switches, can be used most often. The use of ERCs resulting from shutdowns is somewhat more restricted.[7]

Since 1976, there have been over 2,500 offset trades. Most of these transactions have involved ERCs produced contemporaneously with the application for a permit to construct a new source. Approximately 150 trades have involved ERCs transferred from one company to another rather than within a single company. The most active offset trading markets are located in Southern California, particularly in the Los Angeles basin. The South Coast region has been the site of at least 50% of all trades in the United States from 1985 to the present.

Bubbles

The key issue in the EPA's bubble policy is the regulatory treatment of the term "source." In a bubble, two or more emission points can be treated as if they were under a hypothetical dome, creating a single source. Changes in emission levels within a bubble are treated in the aggregate rather than on a point-by-point basis. This treatment greatly increases a source's flexibility in planning compliance with emission limits.

A facility manager using a bubble strategy can "overcontrol" at individual emissions points that are inexpensive to control (on the basis of dollars per unit of pollution abatement) while relaxing controls at emissions points that are more expensive to control as long as the net effect is an air quality improvement. Current rules require a net 20% reduction in total emissions from sources under the bubble. Many firms have found that the flexibility to plan emissions control strategies in-house rather than having them specifically imposed by regulators can result in substantial cost savings.

The EPA generally reserves the right to evaluate proposed bubbles on an individual basis, which causes great delay in bubble approval. However, some states and localities have written "generic" bubble rules and have been granted the authority to approve individual bubbles without EPA oversight. The EPA's

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[7] Although it is often easier to demonstrate permance for shutdowns and installation of pollution control equipment, regulators sometimes restrict use of shutdown-created ERCs to the same industry, the same site, or in other ways.

Emissions Trading Policy Statement establishes a procedure for evaluating the effect of a proposed bubble on baseline emission levels in terms of both ambient impact and enforceability. Air quality modeling is generally required to establish the relevant emission limits and to demonstrate that a net air quality improvement will result from a proposed bubble.

The EPA and several states (under generic rules) have approved approximately 75 bubbles, with several hundred million dollars of savings to applicants. Bubble deals have been closed between two or more different companies as well as within companies.

Of all the uses for ERCs, bubbles have been subject to the most active scrutiny by the EPA. However, this situation could change as state and local regulators become more familiar with the 1986 Emissions Trading Policy Statement, which provides guidelines on bubble applications. Historically, bubbles has been the least common type of emissions trading.

Emissions Banking

Emissions banking is an effort to create continuity and certainty in the markets for ERCs. Banking allows emissions reductions that have been certified as ERCs to be stored for future use, sale, or lease. In theory, banked ERCs can be used in any of the types of transactions described in the preceding three sections—netting, offsets, and bubbles.

Banking creates flexibility in emissions trading in three ways. First, banking rules give firms explicit information about the fate of ERCs over time. This creates a level playing field from which firms can evaluate an investment opportunity involving the creation of ERCs for later use or sale. Second, banking creates a constant supply of credits; this increases the efficiency of ERC markets and reduces transaction costs. Third, banking allows firms to create ERCs when it is most convenient rather than waiting until a willing buyer has been identified. An attractive feature of banking is that it promotes opportunities for suppliers of air pollution reduction mechanisms (such as fuel switching to gas) to market their products on the basis that their use can create a valuable asset (bankable ERCs). The value of banked ERCs usually increases over time.

In its most recent Emissions Trading Policy Statement, the EPA has given states the option to amend their SIPs to include local banking rules. However, few states have taken advantage of this option. Several areas have banking programs that are not included in the applicable SIP. These include the San Francisco Bay area, the Los Angeles area, and the state of New Jersey. These banks are only recognized locally and thus provide depositors with limited protection against the threat of ERC confiscation.

Estimated Cost Savings and Trading Activity

Perhaps because of the difficulty of obtaining data, only a limited number of studies have attempted to quantify the success of emission trading programs. However, it is generally agreed that emission trading programs allow more cost-effective regulation of air emissions than traditional command-and-control approaches. In other words, a given environmental objective can be achieved at lower cost using an emissions trading approach.

Table II-2 summarizes several empirical studies that estimate the costs of traditional command-and-control regulation of selected pollutants and compare these costs with those of market-based control (e.g., emissions trading).[8]

Table II-3 presents the trading activity and estimated cost savings specifically attributable to EPA's emissions trading policy through 1986. The cost savings are estimated to be at least $1 billion and possibly as much as $13 billion.[9] Hahn and Hester conclude that emissions trading has only had an insignificant impact on environmental quality for each type of trade. This conclusion is not surprising given the requirements of the trading programs. Netting requires that a firm offset increased emissions due to a source modification with reductions at other sources on the same site so that the net increase is less than the minimum threshold. Offsets require firms that have new emission sources or large expansions of existing sources to offset their increased emissions through reductions from

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[8] T. H. Tietenberg, "Economic Instruments for Environmental Regulation," *Oxford Review of Economic Policy*, 6, no. 1, p. 24.

[9] The cost savings for netting are stated in terms of 1984 U.S. dollars. Cost savings for bubbles are stated in terms of current dollars at the time each bubble was approved. The source for Table II-3 is R. W. Hahn and G. L. Hester, "Where Did All the Markets Go? An Analysis of EPA's Emission Trading Programs." *Yale Journal Regulation* 6, no. 1 (Winter 1989): 138.

Table II-2
EMPIRICAL STUDIES OF AIR POLLUTION CONTROL

Study	Pollutants Covered	Geographic Area	Command-and-Control (CAC) Benchmark	Ratio of CAC Cost to Least Cost
Atkinson and Lewis	Particulates	St. Louis	SIP regulations	6.00[a]
Roach et al.	Sulphur dioxide	Four corners, Utah	SIP regulations Colorado, Arizona, and New Mexico	4.25
Hahn and Noll	Sulphate standards	Los Angeles	California emission	1.07
Krupnick	Nitrogen dioxide regulations	Baltimore	Proposed RACT	5.96[b]
Seskin et al.	Nitrogen dioxide regulations	Chicago	Proposed RACT	14.40[b]
McGartland	Particulates	Baltimore	SIP regulations	4.18
Spofford	Sulphur dioxide	Lower Delaware Valley	Uniform percentage regulations	1.78
	Particulates	Lower Delaware Valley	Uniform percentage regulations	22.00
Harrison	Airport noise	United States	Mandatory retrofit	1.72[c]
Maloney and Yandle	Hydrocarbons	All domestic DuPont plants	Uniform percentage reduction	4.15[d]
Palmer et al.	CFC emissions from nonaerosol applications	United States	Proposed emission standards	1.96

Notes:

CAC = command and control, the traditional regulatory approach.

SIP = state implementation plan.

RACT = reasonably available control technologies, a set of standards imposed on existing sources in nonattainment areas.

[a] Based on a 40 $\mu g/m^3$ at worst receptor.

[b] Based on a short-term, one-hour average of 250 $\mu g/m^3$.

[c] Because it is a benefit-cost study rather than a cost-effectiveness study, the Harrison comparison of the command-and-control approach with the least-cost allocation involves different benefit levels. Specifically, the benefit levels associated with the least-cost allocation are only 82% of those associated with the command-and-control allocation. To produce cost estimates based on more comparable benefits, as a first approximation, the least-cost allocation was divided by 0.82 and the resulting number was compared with the command-and-control cost.

[d] Based on 85% reduction of emissions from all sources.

Table II-3
SUMMARY OF EMISSIONS TRADING ACTIVITY

Activity	Estimated Number of Internal Transactions	Estimated Number of External Transactions	Estimated Savings (Millions)	Environmental Quality Impact
Netting	5,000 to 12,000	None	$25 to $300 in permitting costs; $500 to $12,000 in emission control costs	Insignificant in individual cases; probably insignificant in aggregate
Offsets	1,800	200	Probably large, but not easily measured	Probably insignificant
Bubbles:				
Federally approved	40	2	$300	Insignificant
State-approved	89	0	$135	Insignificant
Banking	<100	<20	Small	Insignificant

existing sources.[10] Bubble rules currently require a net reduction in emissions. Banked emission reduction credits lower emissions for the period that the ERCs are banked. The emissions trading provisions are designed to facilitate compliance while protecting the environment. Thus, Hahn and Hester's conclusion that emissions trading has only had an insignificant effect on environmental quality is an indication that the emissions trading programs have been successful.

Other estimates place the accumulated capital savings for all components of the emissions trading program at over $10 billion. This conclusion is based on the 7,000 to 12,000 trades that took place nationwide through 1989.[11]

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[10] Offset rules require new or expanding sources to acquire ERCs at least equal to their increased emissions. The offset ratio can be as high as 8:1, but 1.2:1 would be more typical. In these cases, there is a small environmental benefit as a result of the offset. The same applies to banking, where the current rule requires 1.2:1 offset ratio. The net gains due to these offsets is probably small relative to total emissions, hence Hahn and Hester's conclusion that the environmental impact is insignificant.

[11] Tietenberg, "Economic Instruments," p. 19.

Different State and Local Regulatory Characteristics for ERC Trading

Federal policies allow states and regions to employ emissions trading as part of their air emission control strategies. However, ERC markets are regional in nature. Specific state and regional implementation decisions play a key role in encouraging trading activity in each geographic market. The three most important areas of implementation are (1) preconstruction review regulations, which govern netting and offsetting, (2) provisions for compliance bubbles, and (3) the characteristics of state and local banking programs.

State and local preconstruction review regulations differ primarily in the threshold levels that trigger requirements for installing Best Available Control Technology (BACT), for performing an air quality impact analysis, for offsetting emissions increases, and for meeting the Lowest Achievable Emission Rate (LAER). Lower threshold levels result in increased demand for ERCs. State and local regulations may also have specific provisions both for calculating emission increases and for relevant offset ratios. Higher offset ratios decrease the number of sources that can supply ERCs of the required size and increase the total quantity of ERCs demanded.[12]

Key issues shaping local bubble policies include allowable distances between bubbled sources, conditions for multiple-owner bubble trades, applicability of shutdown credits, requirements for monitoring and modeling, and determinations of emission baselines. In general, the level of trading activity decreases with the stringency and mutability of the regulations.

State and local regulations for the banking of ERCs vary in three major ways: (1) program administration, (2) stringency of rules governing creation and ownership of ERCs, and (3) the way in which future changes in emission control requirements affect the amount of creditable ERCs. If the regulations are clearly defined, with little room for uncertainty, the level of trading activity will increase. Banks that provide only limited protection for ERCs dampen trading activity.

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[12] A higher offset ratio requires that a new or expanding source acquire more ERCs for a given expansion, which raises demand. At the same time, the number of existing sources able to provide the required quantity of ERCs falls, which reduces supply.

A higher offset ratio also sets a higher price on emissions control at new sources. With an offset ratio of 1.2:1 emissions reductions may be carried out at existing sources if they cost $1,000 per tonne, but at new sources if they cost $1,200 per tonne. This discriminates against new entrants and does not allow achievement of the most cost-effective set of controls.

CREDIT TRADING FOR LEAD IN GASOLINE

Under the authority of the Clean Air Act, the EPA regulates the content of lead in gasoline. Until 1982, the EPA exercised control by enforcing lead limits on a refiner-by-refiner basis. However, in 1982 it amended the rules to allow for trading among refiners. In other words, a refiner could exceed its limit if it acquired another refiner's right to use lead. Such credits expired quarterly if unused. It is estimated that up to 20% of lead emission rights were traded by 1985.[13]

In 1985, lead standards became approximately ten times more stringent. As part of the new program, EPA set up a "bank" for lead in which emission reductions that were accomplished ahead of schedule (in 1985) could be banked for use or sale in 1986 and 1987. Some 10.6 billion grams of lead were banked,[14] far more than originally expected. Cost savings on the order of hundreds of millions of dollars resulted.

The reasons for the success of the lead trading program are uncertain, but it was probably successful for two reasons. First, there was no cumbersome administrative approval process; refiners simply reported their transactions as part of their regular quarterly reports. Second, there were no geographic constraints; a refiner could trade with any other refiner throughout the United States.

The lead training program ended in 1988. Regulators were concerned that further reductions in lead levels would damage older engines. The lead credit training program is generally considered to have enabled greater reductions in lead content to be achieved more quickly and at a lower cost than they would have been achieved under traditional command-and-control approaches.

TRADEABLE PERMITS FOR OZONE-DEPLETING GASES

As part of its implementation of the Montreal Protocol, the EPA has instituted a system of tradeable permits for ozone-depleting chlorofluorocarbons (CFCs). Under the system, permits are allocated to CFC producers and importers on the basis of historical production and import levels. Each permit is good for a specific year. Allocations decline over time to achieve the international agreement's requirement for a phased reduction in CFC use.

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[13] R. W. Hahn and G. L. Hester, "Marketable Permits: Lessons from Theory and Practice," *Ecology Law Quarterly*. 16, 361–406.

[14] Ibid.

These allowances can be freely traded among producers or other interested parties. Except for a preexisting ban on the use of CFC's for "nonessential" functions (e.g., as aerosol propellants), there are no restrictions. The EPA monitors CFC production and imports and has the ability to track trades. Information on potential buyers and sellers is freely available.

Although no data are available on the cost savings of implementing this trading program, before implementation it was estimated that this program would save some 49% of the cost of a similarly effective command-and-control approach.[15]

The CFC trading program also involves a tax on production and consumption that increases over time. The tax per pound of the chemical sold or used is equal to a base tax multiplied by an "ozone-depleting factor" specific to each chemical. These factors range from a low of 0.8 for CFC-113 to 10.0 for Halon-1301. The tax rates rise from (U.S.) $1.37 in 1991 to $2.65 in 1994 and further increases of 45¢ per year thereafter. This tax complements, rather than substitutes for, the trading program, and it raises revenue, something that other emissions trading programs do not necessarily do.

The U.S. federal emissions trading experience, then, has consisted of some 30 emissions reduction credit trading programs, lead credit trading, and, more recently, CFC allowance trading. Legislation to establish SO_2 allowance trading has also been passed but the program is not yet in operation. Chapter III discusses the ERC trading program and Chapter IV discusses the SO_2 allowance program.

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[15] Adele R. Palmer et al., *Economic Implications of Regulating Chlorofluorocarbon Emission from Nonaerosol Applications* (Rand Corporation, 1980).

III. SUMMARY OF THE EMISSION TRADING EXPERIENCE OF SELECTED JURISDICTIONS

A number of emissions reduction credit (ERC) trading programs have been initiated nationwide. Some programs have met with more success than others. This chapter looks at five of these programs:

- The South Coast Air Quality Management District
- The San Joaquin County Air Pollution Control District
- The Bay Area Air Quality Management District
- The State of New Jersey
- Jefferson County, Kentucky

Appendices A through E provide detailed information on these programs. Each appendix focuses on one program.

This chapter focuses on the factors that have affected the performance of each program. The programs for the South Coast Air Quality Management District and the San Joaquin County Air Pollution Control District are generally considered to be the most successful; consequently, they receive the most attention in the discussion. However, an examination of the characteristics, successes, and difficulties of all five programs provides valuable lessons for the design of successful programs.

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT

The South Coast Air Quality Management District's (SCAQMD's) emissions trading program is the most active program in the United States. SCAQMD initially developed its New Source Review and Banking Rules (Regulation XIII), which allow ERC trading, in 1976. The goal of the SCAQMD emissions trading program is to allow economic growth in the Los Angeles area and South Coast air basin while attaining national air quality standards in the region. To try to meet this goal, SCAQMD has amended its New Source Review Regulation several times. It passed the most significant amendment on June 28, 1990, with an effective date of October 1, 1990.

This discussion focuses on SCAQMD's emissions trading activity from 1987 to 1990 and aspects of the program that contributed to its success. Sufficient data are not yet available to evaluate the post-October 1990 regulations. Appendix A discusses both the pre- and the post-October 1990 rules.

Trading Activity

From 1976 through October 1990, over 100 trades involving more than one firm occurred in the SCAQMD. In the past four years (1987–1990), over 75% of the trades involved ERCs for reactive organic gases (ROG);[16] the average quantity traded ranged from approximately 150 pounds per day (lb/day) to over 300 lb/day. Only one carbon monoxide (CO) trade occurred during this period. Table III-1 summarizes the emissions trading activity in the SCAQMD for the years 1987 through 1990. The volume of trades reflects the relative difficulty of reducing emissions below the minimum threshold for each pollutant. Ozone is the most pressing air quality problem in the SCAQMD so its precursors—ROG and NO_x—have the most stringent thresholds and the highest level of trading activity.

Data are only available for external trades, that is, trades involving more than one firm. Hence, the data in Table III-1 cover only some of the offset trades. The figures do not reflect netting, bubbles, and offset trades internal to a single firm. Although data are not available on internal trades, where such figures have been compiled, internal trades are generally twice as numerous as external trades.

Factors Affecting Program Success

Several factors were critical to the success of emissions trading in the South Coast Air Quality Management District: low offset thresholds, solid economic growth, the availability of shutdown-created credits, an effective permit program, a vigorous and predictable enforcement program, and adequate funding. Despite its success, the SCAQMD emissions trading program is not without its problems: there are time delays in processing applications, staff resource shortages, constantly changing rules, and the potential for the confiscation of banked ERCs remains. This assessment is based on the pre-October 1990 regulation. Appendix A describes the characteristics of the pre-October 1990 regulation.

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[16] Reactive organic gases (ROGs) are virtually identical to volatile organic compounds (VOCs).

Table III-1
SUMMARY OF EXTERNAL EMISSIONS TRADING ACTIVITY IN THE SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
1987 through 1990

	1987	1988	1989	1990
Reactive Organic Gases (ROG)				
Number of trades	17	30	13	13
Average trade size (lb/day)	333	181	153	174
Quantity of trades (lb/day)	5,655	5,425	1,991	2,260
Nitrogen Oxides (NO_x)				
Number of trades	3	2	4	3
Average trade size (lb/day)	106	117	328	69
Quantity of trades (lb/day)	319	233	1,311	206
Sulphur Oxides (SO_x)				
Number of trades	1	0	0	1
Average trade size (lb/day)	3,731	--	--	927
Quantity of trades (lb/day)	3,731	0	0	927
Carbon Monoxide (CO)				
Number of trades	0	1	0	0
Average trade size (lb/day)	--	351	--	--
Quantity of trades (lb/day)	0	351	0	0
Particulate Matter (PM)				
Number of trades	0	2	0	1
Average trade size (lb/day)	--	16	--	32
Quantity of trades (lb/day)	0	32	0	32
Total				
Number of trades	21	35	17	18
Quantity of trades (lb/day)	9,705	6,041	3,302	3,425

Threshold Levels

The minimum threshold level sets the quantity of emissions above which a new emissions source or an expanding existing source must obtain offsets. The lower the minimum thresholds, the greater the number of new emissions sources or expanding existing sources that will need to purchase emission reduction credits from existing sources. The pre-October 1990 Regulation set more stringent minimum thresholds than the national levels for all pollutants except carbon monoxide (CO). Table III-2 shows the pre-October 1990 threshold levels for the

SCAQMD. The ROG threshold of 13 tons per year was substantially lower than the national threshold of 40 tons per year for major source modifications and 100 tons per year for major new sources.

By comparing Table III-1 with Table III-2, the relationship between trading activity and threshold level becomes readily apparent. The pollutants with the lowest thresholds have the most trading activity.

Table III-2
EMISSION THRESHOLD LEVELS
UNDER PRE-OCTOBER 1990 REGULATION XIII

	(SCAQMD) Threshold Level	
Air Pollutant	**lb/day**	**tons/year**
Reactive Organic Gases (ROG)	75	13.7
Nitrogen Oxides (NO_x)	100	18.2
Particulate Matter (PM)	150	27.4
Sulphur Dioxide (SO_2)	150	27.4
Carbon Monoxide (CO)	550	100.4

The October 1990 revisions to SCAQMD Regulation XIII lowered the minimum thresholds to zero for all pollutants. Now all nonexempt new and modified sources must offset all emissions increases through the acquisition of emission reduction credits.

Economic Growth

A key determinant of a successful emissions trading program is economic growth. According to the Draft Air Quality Management Plan for the South Coast air basin (December 1990), the population increased almost 2% per year from 1980 to 1987 and will continue to increase by 1.2% per year between 1987 and 2010. Economic growth induces firms to expand their operations and draws new firms to the region. Thus, it creates a demand for emissions reduction credits and stimulates trading.

Even though regulated sources have been required to reduce their emissions, total emissions of most pollutants have continued to increase in the SCAQMD because emissions from exempt area and mobile sources rose by more than the reductions achieved from regulated point sources.[17] For example, ROG emissions increased approximately 130 tons per day from 1985 to 1987. However, total emissions from regulated sources have declined, so the command-and-control regulations and the associated ERC trading have been successful in achieving the limited goals set for the SCAQMD.

Economic growth stimulates offset trades of emission reduction credits, but it also increases emissions from less tightly regulated sources. Options for addressing emissions from mobile and area sources are now being examined.

Supply of Shutdown-Created ERCs

The SCAQMD allows for the creation and use of shutdown-created credits. The pre-October 1990 rules required that the permit application be submitted before the creation of the emission reduction credit and discounted shutdown-created emission reduction credits by 10%. These requirements did not reduce the use of shutdown-created credits. In fact, there was a ready supply of shutdown-created ERCs; from 1985 to 1990 over 80% of the ERC transfers in offset trades involved shutdown-created credits.

Shutdown credits are relatively easier to create than other ERCs because they do not involve extensive engineering studies, large amounts of equipment, or process redesign. In addition, it is easier to prove that shutdown credits are permanent, real, surplus, quantifiable and enforceable. It is also less expensive to close a plant than to change a process or install additional control equipment. Shutdown-created ERCs are less expensive than other types of credit and administratively they are easier to create.

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[17] A point source is a source whose emissions come from a small, fixed location such as a stack. An area source is a fixed source whose emissions can originate at a variety of locations such as emissions from a landfill site or the building shell of a factory. A mobile source is a moveable source such as an automobile. Fixed sources are generally regulated most stringently and area sources tend to be the least stringently regulated. Emissions reduction credit trading programs only apply to point sources.

Permitting Program

Another key element in the success of the SCAQMD emissions trading program was the implementation of a well-defined permitting program. Under the pre-October 1990 rules, with only a few exceptions, any stationary source that emitted a nonattainment pollutant was required to obtain a permit. In addition, if the expected emissions from a new source or the expansion of an existing source exceeded the threshold level (as listed in Table III-2), the source had to obtain offsets from existing sources for those emissions.

Enforcement Program

The SCAQMD enforced the permitting program and offset requirements rigorously. The fine for not obtaining offsets could be as high as $25,000 per violation per day. Regular SCAQMD inspections, audits, and reporting requirements ensured that emission increases that triggered offset requirements would probably be detected by the SCAQMD.

Adequate Funding

The SCAQMD charges a fee to apply for ERCs, to transfer ERCs and to split the ERC certificate. Each year the SCAQMD reviews its fee schedule to ensure that all its costs are recovered through permit fees. Currently, the cost to apply for an ERC is $1,700 per application, and the cost for transferring or splitting the certificate is $300.

Time Delays in Processing Applications

Firms and other sources submitting ERC applications or permit applications have experienced significant delays in the processing of the applications. An ERC application typically takes at least 3 months to be processed but can take as long as 12 months.

Staff Resource Shortages

Part of the reason for the delay in processing applications was a shortage of staff resources. The SCAQMD has not been able to coordinate its staff with resource demands. One of the difficulties in scheduling staff time is the dramatic and sudden changes in work loads when regulations change.

Changing Rules

The California Air Quality Management Plan (AQMP) requires the SCAQMD to revise its regulations to impose more stringent controls on certain types of equipment and processes over time. Consequently, the SCAQMD rules and regulations are constantly changing, which creates uncertainty for the regulated community and makes it difficult for the SCAQMD to plan its staff time.

Confiscation of ERCs

The SCAQMD is allowed to confiscate some or all ERCs. Even though a bank exists, it does not guarantee the preservation of the credits. When SCAQMD revised Regulation XIII in October 1990, it confiscated 80% of shutdown-created credits in the bank. Confiscating emission reduction credits is appealing because it prevents the future increases in emissions that those ERCs allow without acquiring any further investment. However, the threat of confiscation makes it less attractive to bank ERCs, which makes trading a more cumbersome process.

Changes since October 1990

A number of changes have taken place since October 1990. In addition to the zero thresholds mentioned earlier, these changes include:

- A community bank from which small businesses and essential public services can obtain ERCs;[18]

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[18] A community bank differs from a regular bank in terms of the origins of the ERC deposits, the sources eligible to withdraw ERCs from the bank, and the terms under which ERCs are obtained. See Appendix B, page B-10.

- Adjustment of actual emissions for BACT when creating an ERC; and

- Geographic restrictions on trading ERCs within the SCAQMD.

The SCAQMD is currently developing a marketable permit system for both NO_x and ROG to replace the current combination of command-and-control regulations and ERC trading. Both the post-October 1990 changes and the proposed marketable permit system are described in Appendix A.

SAN JOAQUIN COUNTY AIR POLLUTION CONTROL DISTRICT

The emissions trading program for the San Joaquin County Air Pollution Control District (SJCAPCD) originated on May 29, 1979, with the passage of Regulation 2, Rule 209.1—New and Modified Stationary Source Review. The county adopted its Emission Reduction Credit Banking Rule in 1987.

Trading Activity

Since the creation of the ERC bank, 2,275 tons of ERCs have been deposited and 12 offset trades have taken place. Most ERCs in the SJCAPCD bank were created through process modifications or the addition of control equipment rather than through shutdowns. Trades have ranged in size from 1.6 tons per year to over 500 tons per year. Although the total number of offset trades in the SJCAPCD appears low in comparison to the number of trades in the South Coast Air Quality Management District, it is important to keep in mind that San Joaquin County is primarily a rural agricultural community.

Factors Affecting Program Success

San Joaquin County's emission reduction credit trading program is generally regarded as a success. Although trading activity is low relative to that in the SCAQMD, it is much higher in San Joaquin County on a per capita basis. The factors that account for the success of the SJCAPD program include support within the regulatory agency and support in the regulated community. This program is also noteworthy for its low proportion of shutdown-created ERCs and the protection it provides to banked credits.[19]

Prevalence of Industry in San Joaquin County

San Joaquin County's trading program has enjoyed considerable success even though the area is partly urban and partly agricultural. The county is an agricultural area, but it is also a bedroom community for the San Francisco area. Despite the fact that San Joaquin County does not have a large and growing industrial sector, the emissions trading program has been successful.

Regulatory Agency Support for Emission Trading

Of primary importance to the success of the SJCAPCD's trading program was the unwavering support of an individual within the regulatory agency who championed the establishment of an emissions bank and the adoption of provisions for ERC trading. Support for the program within the agency was critical to laying the initial groundwork for the program and in ensuring its continued success.

Industrial Acceptance of Emissions Trading

Industry participated in the initial decision making concerning the creation of the emissions trading program. Rather than fighting provisions drafted without its input, industry was able to contribute to the rule-making process. In fact, there was no active opposition to the establishment of an emissions trading program.

Nature of the Emission Reductions in the SJCAPCD Emissions Bank

One important element of the SJCAPCD emissions banking and trading program was that most facilities that have created emission reductions have done so through the addition of pollution control devices to their processes. The San

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[19] This discussion focuses primarily on San Joaquin County rules that were in effect prior to the formation of the San Joaquin Valley Unified Air Pollution Control District in March 1991. It is expected that the New Source Review and Banking rules for this district, which includes the eight counties in the San Joaquin Valley Air Basin, will be adopted in mid-September 1991.

Joaquin County emissions bank primarily contains credits created through the addition of additional controls and process modifications. By contrast, the ERCs in many other air pollution control districts are composed largely of emission reductions created through facility shutdowns. San Joaquin County's program has provided the benefit that has been one of the primary selling points of an emissions trading program at the federal level, namely, that it fosters the introduction of new pollution control techniques that go beyond existing technology and federal and state requirements.

Protection of Banked Credits

Unlike many emissions banking programs, which either suggest that banked emissions may be adjusted by future emission reduction requirements or simply do not address the issue, SJCAPCD Rule 209.5 provides explicit guarantees to owners of banked emission reduction credits. The SJCAPCD rules require that before any adjustments of banked credits can be made, the air pollution control officer (APCO) must prove to the public that the necessary emission reductions cannot be achieved through the imposition of additional controls on existing permitted *or* unpermitted sources. If the APCO can prove that the emission reductions cannot be achieved in that manner, the APCO must place a moratorium on future banking of credits before making adjustments to existing banked ERCs. Such an adjustment requires notice to every ERC holder and the right to a public hearing to discuss the potential adjustment. The protection that the San Joaquin County banking rules afford ERC owners was critical to the enthusiastic participation of the industrial community in the emissions trading program.

The San Joaquin Valley Unified Air Pollution Control District

In March 1991, San Joaquin County became part of the San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD). The new source review and banking rules for the unified district are expected to be adopted in September 1991. It is expected that the SJVUAPCD will adopt zero threshold levels for NO_x, VOCs and CO in nonattainment areas. The threshold levels in other areas and for other pollutants will be maintained at current levels, which are generally below the federal threshold levels.

Offset ratios will change slightly to range from 1.2:1 to 3:1 depending on the distance between the two sources. These offset ratios are higher than those in other California jurisdictions, but similar to those in New Jersey. The new SJVUAPCD is also expected to create a community bank for use by small private- and public-sector sources. The major provisions of the draft new source review and banking rules for the SJVUAPCD are outlined in Appendix B.

BAY AREA AIR QUALITY MANAGEMENT DISTRICT

The Bay Area Air Quality Management District's (BAAQMD) Emissions Banking Program (Regulation 2, Rule 4) was adopted March 7, 1984. It was designed to help sources obtain the offsets they need to comply with the New Source Review regulations. It applies to new sources and sources undergoing major modifications. Bankable compounds include precursor organic compounds (POCs), nonprecursor organic compounds, particulate matter, PM10, sulphur dioxide, nitrogen oxides and carbon monoxide.

The program was amended on July 17, 1991, in accordance with the recent California Clean Air Act's "no net increase" provisions. This summary deals primarily with the experience under the original regulations. A description of the original program and the proposed changes are provided in Appendix C.

Trading Activity

Table III-3 summarizes the banking and trading activity that has occurred to date.

Table III-3
EMISSIONS REDUCTION CREDIT TRADING ACTIVITY IN THE BAAQMD

	Cumulative Reductions 1985 through mid-1991					
	Part	Pre Org	NO_x	SO_2	CO	NonPre Org
Retrofit Air Control Technology (RACT) reductions to date (tons/year)	194	2610	1354	685	1343	105
Unresolved proposed reductions* (tons/year)	4	1959	101	2100	6	16
Withdrawals for use** (tons/year)	5	1822	124	25	8	0
Current bank balances (tons/year)	163	1720	1295	1179	392	218

* Includes incomplete applications and disputed results from years past.
**The percentage of internal versus third-party trades is unknown.

Trading activity is reflected in the "withdrawals for use" figures. The withdrawals have involved only 29 transactions: 4 for particulates, 17 for precursor organic compounds, 6 for NO_x and 1 each for SO_2 and CO. In the case of precursor organic compounds, where most of the trading activity has occurred, 2 of the 17 transactions accounted for 68% of the quantity withdrawn. Although exact figures are not available, most trades were internal, rather than external, transactions.

Factors Affecting Program Success

This program has only received limited use, primarily because its offset thresholds have been high. However, there are factors by which to recommend the program such as the availability of a banking register and the protection of banked ERCs.

Threshold Levels Too High

The main reason the program has not received more use to date is that the offset threshold levels have been too high. Given the high thresholds, most new and modified sources were exempt from the offset requirement. Consequently, there were few buyers and little incentive to create ERCs.

The offset thresholds for POCs and NO_x were 40 tons per year and 100 tons per year, respectively. These compare to 13 tons per year for ROG and 18 tons per year for NO_x in the South Coast Air Quality Management District. The new rules set the threshold at 1 ton per year for both POCs and NO_x, closely paralleling the move to zero thresholds in the SCAQMD and the SJVUAPCD.

Availability of Information

The district maintains a "banking register" that is available to the public on request. The register contains deposit and withdrawal data. Information on prices and transaction dates is not available.

Information on potential sellers is readily available to ERC buyers through the banking register. Freely available information is important if a market is to function efficiently.

Protection of Banked ERCs

Deposits are permanent until used or transferred. ERCs are not reduced on withdrawal. There has been no history of ERC confiscation.

Because there is no history of ERC confiscation and because ERCs are not reduced on withdrawal, a potential depositor can be confident of the security of its investment.

Revised Trading Rules

The recent California Clean Air Act requires the following standards: no net increase in total emissions followed by annual reductions in total emissions until the ambient air quality standards are achieved. The recent revisions in the trading rules of the BAAQMD are designed to help meet these requirements. The main change is to dramatically reduce the emissions thresholds that must be achieved through BACT technology and beyond which emissions offsets must be acquired.

There is considerable concern that the lower thresholds will serve as a barrier to economic growth in the Bay Area. Virtually all new and expanding sources, regardless of size, will be affected even though their potential for on-site reduction of emissions may be limited. However, because these changes are the result of the California Clean Air Act, similar changes are occurring in other parts of the state. Thus, the San Francisco Bay Area may not be at a competitive disadvantage within the state, but California may be at a locational disadvantage relative to the rest of the country, where less restrictive requirements prevail.

NEW JERSEY

New Jersey's Emission Trading Program applies to new or significantly altered stationary sources whose emissions of a criteria pollutant have increased 50 tons or more since 1976. Criteria pollutants include ozone, TSP, sulphur dioxide, nitrogen dioxide, volatile organic compounds, carbon monoxide, and lead. A description of the program is provided in Appendix D.

Trading Activity

The following are rough approximations of the ERC deposits that have been banked in recent years. In most cases, only a handful of companies are involved.

	Banked Emissions Reduction Credits (tons/year)				
	Part	NO_x	SO_2	CO	VOC
1989	156	62	88	9	243
1990	143	43	7	34	330
1991	4	53	100	13	13

Details on the number of transactions are not available. As is the case in most jurisdictions, a large majority of the trades are believed to be internal to a single firm. It is estimated that fewer than ten third-party trades have occurred in the history of the program.

Factors Affecting Program Success

A number of program characteristics have influenced the level of trading activity. These include high offset thresholds, slow economic growth, restrictions on the use of offsets, and uncertainties surrounding banked ERCs. On the other hand, the administrative process is relatively simple, expeditious, and inexpensive.

High Offset Thresholds

New Jersey uses the relatively high threshold levels established by the federal Clean Air Act. With these thresholds, relatively few new sources or major expansions trigger the offset requirement. Hence, there has been little demand for ERCs to meet offset requirements.

New Jersey also requires that the ERCs used as offsets be of like quality and nature to the emissions being offset. In the case of SO_2, lead, and suspended particulates, the effective stack height must be no greater than that of the emissions being offset. A lead ERC must come from the same facility as the increase and winter VOC reductions may not be used to offset summer increases.

Economic Growth

Economic growth in New Jersey has been slow. Consequently, the number of new sources and major expansions of existing sources in the state has been relatively small. The slow economic growth has increased the supply of emission reduction credits. Once created, these ERCs can be banked until a buyer is found. The slow economic growth is reflected in the relatively large balances of shutdown-created ERCs in the emissions bank.

Uncertainties With Banked ERCs

There is no guarantee that banked emissions will be available in their entirety at a later date. If necessary to meet ambient air quality standards, ERCs can be discounted after they have been banked. On withdrawal or transfer to another party, banked reductions are recalculated according to the regulations in place at the time of the transfer. Arguably, there is little incentive to invest the time and money in applying for and verifying emission reductions if there is a significant risk that the asset will be depreciated later. However, if a plant shutdown occurs and the cost and administrative requirements for creating ERC are low, then the decision is different. Although the banked ERC may be discounted, it is still probably worth pursuing.

Simple Administration

Applications for ERCs must be submitted within 12 months of creation. For a shutdown, the department must be notified at least 60 days prior to the removal of the equipment so that inspection is possible. The application consists of a single form and is accompanied by a $400 fee per source. Field office verification and site inspection is generally required for ERC verification, although there are some exceptions. The elapsed time between submitting the application and the approved banking of ERCs can extend up to six months. There is no provision for public participation in the decision to issue ERCs.

To transfer an ERC, a notarized letter on the seller's letterhead, signed by both the seller and the buyer, is required. A $50 fee per transfer per source is also assessed. A new certificate is generally issued within a week.

JEFFERSON COUNTY, KENTUCKY

The Jefferson County Air Pollution Control District adopted its emissions trading program on April 21, 1982 (Regulation 2.12). The program is intended to improve air quality. In theory, it applies to stationary sources emitting any permitted pollutant. In practice, the program has been used for particulates, sulphur dioxide, and VOCs. A description of the program is contained in Appendix E.

Trading Activity

According to the Hahn and Hester, as of 1989, some 18 firms had deposited ERCs for 26,000 tons of emissions per year into the bank.[20] The bank provided offsets for 9 external and 19 internal trades. Data are not available from the

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[20] Robert W. Hahn and Gordon L. Hester, "Where Did All the Markets Go? An Analysis of EPA's Emissions Trading Program," *Yale Journal on Regulation*, 6, no. 1 (1989): 130.

Jefferson County Air Pollution Control District on individual trades but, it is known that no trades have taken place within the last year.

Although this program was active in its early years, no trades have taken place in recent years. On the other hand, Jefferson County is in attainment for most pollutants and consequently has less incentive for promoting the program.

Factors Affecting Program Success

The early success of the Jefferson County program has been attributed to the existence of few restrictions on the use of banked credits, the availability of a banking ledger, and the support of the EPA.[21]

Economic Growth

Economic growth in the Jefferson County area has declined in recent years. Consequently, the number of new sources and major modifications of existing sources that require offsets has declined.

Jefferson County is in attainment for most pollutants and its offset thresholds are relatively high. Both these factors limit the demand for ERCs.

Few Restrictions on the Use of ERCs

The program places few restrictions on the use of banked credits. Consequently, buyers of ERCs had a relatively large number of potential sellers with whom they could negotiate.

Availability of Information

A banking ledger is publicly available and can be used to identify potential sellers. The relative availability of information improves the efficiency of the ERC trading market.

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[21] Ibid.

EPA Support

In the early days of the program, EPA actively supported emissions trading. In recent years, EPA is said to have given less support to ERC trading.

Marketing

The local chamber of commerce promoted emissions trading when it was first established as a means of encouraging new business to come to the area. However, it no longer markets the emissions trading program.

Administrative Process

ERCs can be applied for up to ten years after the actual reduction takes place. Generally speaking, an informal meeting between the applicant and the district takes place before an application is completed and filed. In addition to a completed application form, the applicant must also document the emissions baseline on which the reduction is based. There is no application fee to register for ERCs. The only fee involves the issuance of the permit to operate. The review process takes between 60 and 90 days from the time that a completed application is submitted. District review, which consists of emissions reduction verification, is usually thorough. At the end of the review process, the permit issuance process begins. The process takes approximately one month.

IV. U.S. ACID RAIN ALLOWANCE TRADING PROVISIONS

SO_2 ALLOWANCE TRADING PROVISIONS

Title IV of the 1990 Clean Air Act Amendments set three major goals:

- A reduction in SO_2 emissions of ten million tons per year below 1980 levels by the year 2000;
- A nationwide cap on SO_2 emissions, beginning in the year 2000; and
- A two million ton per year reduction in NO_x emissions.

These goals are to be met through a two-phase program. In Phase I (beginning in 1995), part of the SO_2 and NO_x reductions are to be achieved through emission reduction requirements at the largest, highest-emitting power plants. During Phase II, the SO_2 and NO_x reduction goals are to be reached through more stringent emissions requirements at virtually all fossil-fuel power plants.

An important feature of Title IV is the creation of tradeable SO_2 allowances to facilitate achievement of the emissions targets by the regulated sources. Each allowance permits the holder to emit one ton of SO_2. Each regulated unit is allocated allowances in proportion to its base year emissions. The total number of allowances issued in a given year is equal to the target emissions for that year. A source must hold allowances equal to its actual emissions and can comply through any combination of emissions reductions (by whatever means) and the purchase or sale of allowances.

The rules governing SO_2 allowance trading are currently in draft form. The EPA is expected to propose draft final rules in September 1991 and to adopt final rules by May 1992. A description of the SO_2 allowance trading program based on the draft rules is provided in Appendix F. This chapter summarizes the information in that appendix and highlights some of the features intended to increase the effectiveness of the trading program.

ALLOCATION OF ALLOWANCES

Generally speaking, the EPA will allocate allowances to utility units in operation as of the date of the amendments. The number of allowances per unit is specified in the act for Phase I, and a formula for calculation of the number of allowances per unit is specified for Phase II.[22]

Although an affected unit is allocated a number of allowances in a given year in proportion to its baseline emissions, it will not receive its full allocation. The EPA will withhold 2.8% of the allocations for distribution through auctions and direct sales. The sale proceeds will be distributed to the original allowance holders. The EPA will also reduce Phase II allocations to create certain allowance reserves.[23] These provisions are designed to ensure that a viable market in SO_2 allowances is created and maintained. The withholding of allowances for sale means that large sources cannot dominate the market.

Although the total number of allowances is fixed, unallocated or unused allowances, together with the allowances held in reserves, can be obtained under certain conditions through the following means:

- Installation of scrubbers at utility units specified under the law;
- Purchase of unused allowances from other utilities;
- Purchase from a fixed price (1990 U.S. $1,500 per allowance) reserve held by the EPA;
- Purchase by sealed bid auction, beginning in 1993, from allowances allocated from a special reserve by the EPA;[24]
- Early compliance with Phase II requirements in the years 1995–1999;[25] and

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[22] Katten, Muchin and Zavis, *Bulletin* (November 1990), p. 5.

[23] Reinier Lock and Dennis P. Harkawik, eds., *The New Clean Air Act: Compliance and Opportunity* (Public Utility Reports, Inc. 1991), p. 22.

[24] Katten, Muchin and Zavis, *Bulletin* p. 6.

[25] Lock and Harkawik, *New Clean Air Act*, p. 26.

- Use of energy conservation and renewable energy to obtain (on a first come, first served basis) some of the 300,000 allowances (up to 30,000 annually) scheduled to be set aside for this purpose.[26]

The allowances sold by auction and by fixed price will come from a reserve that the EPA will create by withholding 2.8% of the allowances to be allocated each year. Revenue from the sale of the allowances will be distributed to the allowance holders.

Where more than one unit's emissions flow through a single stack, EPA will aggregate the units' allowances for the purpose of determining compliance.[27] However, this aggregation is not to be confused with a "bubble" approach. Compliance with the act is to be based exclusively on unit-by-unit emissions and allowance holdings.[28]

Units within a utility system or power pool can opt to pool allowances if they meet certain conditions. Under a pooling arrangement, temporary increases or decreases in emissions levels would not require allowance transfers, provided that the total emissions in the pool do not exceed the total allowances held. Again, long-term compliance is based on unit-by-unit emissions and if total allowances are exceeded, all of the pooled units are treated as being out of compliance.

Opt-In Provisions

Under Section 410, nonutility sources of sulphur dioxide are allowed to "opt in" to the allowance trading program, that is, they may elect to be considered as affected units under Title IV. To opt in, the owner or operator must submit a permit application and a proposed compliance plan to EPA for approval. The baseline used for a unit opting in under this section will be the fuel consumption and operating data for the calendar years 1985 through 1987. The actual emissions limit for these sources will be equal to the product of the baseline multiplied by the lesser of the unit's actual or allowable emissions rates (in pounds per mmBtu) divided by 2000. Generally speaking, units opting in under this section may not transfer or bank allowances produced through reduced use or shutdown of a facility. Units opting in will become subject to the monitoring, reporting, record-keeping requirements and penalties of Title IV.[29] The proposed rules governing this section of the act are not expected until 1992.

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[26] To qualify for these allowances, criteria apply. For example, a utility must have a least-cost plan in place.

[27] EPA, "OMB/ATAC Draft," June 21, 1991, p. 111.

[28] Ibid., p. 107.

Permit Applications and Compliance Plans

Compliance will be accomplished through the permits issued to affected sources. It will be illegal for a source to operate without a permit. The burden of ensuring that an affected source is permitted will fall on the responsible official for the source. Compliance plans will be required for each affected unit except where multiunit provisions have been invoked. It is also proposed that monitoring plans be required in conjunction with permit applications.

Administrative Requirements

The rules, as proposed, require that all applications be submitted on four simple EPA-issued forms. This procedure is intended to ensure national consistency in informational requirements and to facilitate the market (in that utilities in different states will have the same administrative burden). The forms have been designed to be compatible with electronic reporting.

Trading with Nitrogen Oxides

By January 1994, the EPA will provide to Congress an evaluation of the consequences of amending Title IV to allow the trading of sulphur dioxide allowances for nitrogen oxide allowances.

ALLOWANCES COMPARED WITH ERCs

Allowances differ from the more traditional emission reduction credits in a number of ways. First, the nature of the tradeable permit itself is different. Unlike an ERC, which represents a continuous stream of permitted emissions (for example, x tons per year) and is generally valid in perpetuity, an allowance represents one allowable ton of sulfur dioxide (SO_2) in a particular calendar year. An allowance for a particular calendar year can be banked and utilized in a future calendar year; however, an allowance for a future calendar year can not be utilized early. Second, the parties involved in the trades are different. While the ownership of ERCs is generally limited to and traded between affected sources and special banks, any entity (including individuals) can buy and sell allowances. Third, the geographic boundaries are different. While ERCs are usually limited to use within the same ambient impact area as they were created, allowances can be traded, banked, or used nationwide.

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[29] Lock and Harkawik, *New Clean Air Act*, p. 21.

ESTIMATED COST SAVINGS

The estimated cost savings attributable to the SO_2 allowance trading program have been estimated for the EPA. The cost savings are divided into two broad categories; costs related to SO_2 emissions reductions and costs related to regulatory implementation. The estimate for these two categories of savings are discussed in turn.

COSTS RELATED TO SO_2 EMISSIONS REDUCTIONS

The costs of SO_2 emissions reductions were estimated with a detailed linear programming model that computes the electric utility industry's lowest cost responses to the emissions control requirements. The costs of SO_2 control are estimated assuming that the target reductions are achieved through command-and-control regulations and through allowance trading. In each case, a high and low scenario is analyzed for the period 1993 through 2020. Costs are expressed as a present value at the beginning of 1992 using a 3% real discount rate.

The costs of achieving the SO_2 reductions through command-and-control measures is estimated at between $19.1 and $30.9 billion dollars. With allowance trading, the estimated compliance costs range between $9.5 and $17.1 billion dollars. Hence, allowance trading reduces compliance costs by $9.6 to $13.8 billion, or 45-50% of the cost of the command-and-control approach.

The SO_2 control costs, although large in absolute terms, are small relative to the roughly $200 billion annual cost of generating electricity. The requirements to control SO_2 with an allowance trading approach will raise the average cost of electricity 0.5–0.7% over the period on a "levelized" basis.

COSTS RELATED TO REGULATORY IMPLEMENTATION

Implementation of SO_2 control regulations will impose higher costs on industry and government. Estimates of these added costs are presented in Table IV-1. The estimates indicate that both industry and government will incur higher administration and monitoring costs with an allowance trading program. The incremental regulatory costs range between $653 and $856 million, or 4–6% of compliance cost savings. The allowance trading program is still expected to yield large overall savings.

Most of the added administration and monitoring costs fall on industry, which also realizes the compliance cost savings. The added costs to government are $29 to $31 million (present value over the 18 years). These incremental costs may be overstated because the costs of the command-and-control approach do not include the costs of developing and revising the BACT and RACT standards and other rules and regulations that such a system would require.

Although it is not addressed in the study, a system of fees to cover the costs of administering the trading program is common in many jurisdictions. If these estimates are of the right order of magnitude, the fees would constitute only a small fraction of the overall compliance cost savings.

PROJECTED SUCCESS

Designed with some of the experience of ERC, CFC, and lead trading in mind, the allowance trading program as proposed has a number of factors working in its favor. First, representatives of the diverse interests affected are an integral part of the program-planning process. Second, a market-priming mechanism is proposed

Table IV-1
ADMINISTRATION AND MONITORING COSTS
(Millions of Dollars)

	Command and Control	Allowance Trading	Increased Cost
Industry			
Monitoring, CEM	2,225	2,610	385
Arranging allowance transfers	0	200 to 400	200 to 400
Market-enhancing activities	0	0.4	0.4
Permits	0	36.4	36.4
Conservation and renewables	0	2.0 to 3.2	2.0 to 3.2
Total industry	2,225	2,849 to 3,050	624 to 825
Government			
Monitoring, CEM	0	2	2
Allowance-tracking system	0	2.1 to 4.2	2.1 to 4.2
Allowance transfer	0	1.8	1.8
Market-enhancing activities	0	0.5	0.5
Permits	0	21.9	21.9
Conservation and renewables	0	0.1	0.1
Total government	0	29 to 31	29 to 31
TOTAL	2,225	2,888 to 3,081	653 to 856

Source: ICF Incorporated, *Regulatory Impact Analysis of the Proposed Acid Rain Implementation Regulations* (draft), June 20, 1991.

to ensure that trades actually occur. A small percentage of each unit's annual allocation will be withheld so that some action (emissions reduction or allowance trading) is required to achieve emissions compliance. Third, the potential market for allowances is extensive. Because there are no restrictions on who can use allowances, there are no geographic limitations on who can utilize allowances, and because information on prices and ownership are expected to be readily available, allowances are expected to be desirable commodities and to provide the necessary base for a market. These points are explained in more detail below.

Representatives of the diverse interests affected by SO_2 allowance trading are involved in the program-planning process. The proposed rules have been drafted in cooperation with the Acid Rain Advisory Committee—a committee consisting of 44 representatives of industry, government, environmentalists and other interest groups. The allowance trading provisions of the statute itself were originally proposed by the Environmental Defense Fund, a prominent nonprofit environmental protection group. It is anticipated that early participation and negotiation among affected interests will provide future support for (and prevent future opposition to) the proposed rules and their implementation.

The program as proposed incorporates a market-priming mechanism. Specifically, utilities will receive less than their full allocation of allowances, so they will be forced to either reduce emissions or to acquire allowances to come into compliance. The withheld allowances themselves will be available through auctions and direct sales. Utilities are expected to choose the most cost-effective option for achieving compliance. In this way, they will satisfy both their own self-interest and the purpose of the act by reducing SO_2 where it is most efficient for them to do so. The sale of withheld allowances also serves to ensure that a few large sources cannot affect the market for SO_2 allowances.

The market for trading allowances is expected to be virtually unlimited. Because allowance ownership is not limited to particular sources in particular regions, there will be many opportunities to execute trades. The Chicago Board of Trade has announced that it will introduce trading of SO_2 allowance futures. Pertinent information on SO_2 allowance ownership will be readily accessible and will facilitate competitive market behavior. Overall, the market potential for allowances is expected to be far greater than has been the case with the trading of ERCs.

V. FACTORS CRITICAL TO A SUCCESSFUL TRADING PROGRAM

This chapter summarizes the factors critical to successful establishment and operation of an emissions trading program. The recommendations are based on information found in Chapter III, which summarizes the experience of several emissions trading programs in the United States, and other studies of trading programs. Knowledge about the factors that contribute to the success of these programs will help the architects of the air quality attainment program for the Lower Fraser Valley determine if an emissions trading program can play a role in achieving air quality objectives and, if so, how such a program should be designed given the unique characteristics of the area. Twelve success factors are important; each is discussed in turn.

CLEARLY DEFINED GOALS

As originally conceived and implemented, the United States federal new-source review emissions trading program had one goal: to accommodate growth without degrading air quality. Before the institution of emissions trading, regulators responsible for new-source review only had one option when a major source sought to site in a nonattainment area without growth allowances: deny the permit. Emissions trading provided a second option: allow the source to site so long as its expected emission increases were offset by compensating emission reductions secured from other sources in the area. Until recently, most trading programs in the Unites States—including all those described in Chapter III—were based on this goal of maintaining air quality.

In recent years, regulators have ascribed different goals to their emissions trading programs. Rather than simply viewing the program as a tool to maintain the status quo, they began to look to emissions trading as a means to facilitate emission reductions. New emission sources and expanded existing sources are required to offset their own emission increases as well as to offset an additional increment to benefit the air basin. This additional increment may be as little as 5% or as much as 300% of the expected increase. The rules described in Chapter III, together with their newly adopted revisions, include these expanded attainment-related goals. The same can be said of the new SO_2 allowance trading program, which is designed to reduce emissions by ten million tons below 1980 levels.

It is a mistake, however, to characterize an attainment-oriented program as a failure if the air quality problem persists. Observers often point to the SCAQMD as an area where the emissions trading program has failed. Their conclusions are based on the fact that the air pollution problem persists year after year. However, as measured against its goal—to ensure that new sources do not make the air quality worse—the program is quite successful. All the major new sources that the program has covered have secured offsets. The air quality problem persists for other reasons, namely, that most sources have been exempt from the requirement to obtain emission offsets; that indirect and areawide emissions are difficult to regulate and have been largely overlooked to date, and that most emissions come from mobile sources that are exempt from offset requirements.

A clear statement of the goal of the emissions trading program is important, as is measuring the program's performance against that goal.

PARTICIPATION PROPORTIONAL TO PROBLEM CONTRIBUTION

The universe of sources that will participate in an emissions trading program should be defined by the emissions trading rule and be related to the goal of the program. If the goal is to ensure that the air quality does not degrade due to new-source siting activity, the setting of a low threshold that triggers the need to secure offsets will help ensure the success of the program. If the goal of the program is to accomplish areawide emission reductions, the requirement that a broad sector of polluting sources participate in the program will contribute to its success.

In the case of new-source review programs, offset thresholds have historically been too high to accomplish the goal of ensuring that air quality does not degrade. Studies have shown that most emission increases are associated with new and modified sources whose emission increases are of a size that is exempt from the need to secure offsets.[30] Thus, although sources subject to offset requirements do secure offsets, the sources that are primarily responsible for the air quality problem are often exempt from the need to secure offsets.

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[30] See AB2162 Technical Review Group, California Air Pollution Control Officers Association, State of California Air Resources Board, Stationary Source Division, *Systems and New Source Review Programs: A Report to the Legislature* (December 1988). This study found that between 1976 and 1986 more than 80% of ROG emission increases in the SCAQMD were exempt from offset requirements due to the fact their emission increases were less than the offset threshold.

With respect to an allowance-based program, it is similarly important to ensure that participating source categories be selected on the basis of their overall contribution to the air quality problem. For example, it would be impractical to seek to achieve an annual 5% reduction in air basin emissions through an allowance-based program if such a program were directed at a source category that represented less than 20% of the emissions inventory. In such a scenario, covered sources would have to reduce their emissions not by 5%, but by 25% per year.

A critical aspect of a successful air quality management program that sources participate in the program in proportion to their contribution to the air quality problem. For any given source category, the program objectives can be achieved through command-and-control regulation, an emissions trading program, or a combination of the two.

A QUALITY EMISSIONS INVENTORY

Successful emissions trading programs are based on emissions inventories that accurately represent all sources. Inadequate data on the sources covered by the emissions trading program will make it difficult to assess the program's degree of success. Emissions inventories should also include both permitted and unpermitted sources. This is true for both emissions reduction credit trading programs designed to maintain air quality as well as allowance-based programs designed to improve air quality.

There are several reasons why emissions inventories can be of poor quality: they have inadequate information on the sources included in the inventory, the inventory is based on allowable emissions rather than actual emissions, or some sources are excluded from the inventory. When sources are excluded from the inventory, they are able to escape the purview of the regulator and do not need to secure offsets.

Furthermore, a regulator's ability to achieve a basinwide emission reduction objective as measured from a baseline will be frustrated if the data on which the baseline is founded are suspect. Planning and program evaluation will be highly suspect where there is no confidence in the accuracy of the emissions inventory.

Those who seek to design and implement an emissions trading program will find their job more difficult if the inventory is inadequate. Program evaluators will find their job nearly impossible to perform. The emissions inventory must be of high quality from the start, and it must be regularly updated. It must include permitted and unpermitted emissions, point source emissions and fugitive emissions and the data must be accurate.

COMPREHENSIVE PERMIT SYSTEM

The requirement that sources covered by an emissions trading program must obtain an air quality permit is critical. The regulator must have a means to bring sources into the system, ensure that new sources secure compensating offsets, and make certain that sources meet their continuing emission reduction objectives. And the sources must know the standards with which they must comply. The sources must also understand that if they meet the appropriate standards, the regulator will not hinder their operation.

A program that requires businesses to gain advance approvals before a source is constructed, operated, or modified and that requires the maintenance of this approval during the lifetime of the facility is critical to the success of an emissions trading program. With such a program in place, the regulator can ensure that compensating offsets are secured prior to operation and that annual reduction targets, if any, are met. Failure to meet these requirements should result in revocation of the permit, fines, penalties, or other sanctions.

All of the California programs described in Chapter III have stationary point requirements and are in the process of expanding them to cover previously exempt sources. Because air quality problems were often caused by small, nonpermitted sources, many California programs (e.g., SCAQMD, SJVUAPCD, and BAAQMD) have adopted regulations that require nearly every emitting point source to secure permits and to obtain emission offsets. The United States Congress also changed federal rules to tighten the emission offset thresholds and associated permit requirements.

A permit system is critical to the success of an emissions trading program. If the permit program is loose or only applies to a limited number of sources, the regulator loses a means to control the air quality problem and to manage its solution.[31]

CREDIBLE ENFORCEMENT THREAT

Sources that are covered by a trading program must know that there is a significant risk associated with their failure to secure required offsets or allowances. The penalty should significantly exceed the cost of acquiring offsets or allowances. Sources must know that the cost to comply with the offset or allowance requirement is significantly smaller than the penalty associated with failure to comply with relevant rules.

In the SCAQMD, the penalty for noncompliance with offset provisions is as much as $25,000 per violation per day, the possibility of permit revocation, and potential civil or criminal penalties that can be imposed on the owner or operator. Similar penalties are provided for in the BAAQMD and SJCAPCD rules. The new SO_2 allowance program provides for a $2,000 per ton penalty plus a requirement to acquire allowances to cover the excess emissions. This penalty clearly exceeds the cost of compliance and ensures that the environment is protected.

The program must also include a means by which the regulator can determine noncompliance. Annual emissions reporting, facility inspections, source testing, and, of course, a comprehensive permitting system are important parts of an enforcement program.[32] The absence of these elements will leave the door open for noncompliance and will undermine the trading program.

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[31] All of the emission reduction credit trading systems and most command-and-control regulations have been implemented without a comprehensive permit system for all sources. Ideally, a quality emissions inventory will be available to enable regulators to establish the contribution of each source category. An appropriate regulatory approach—command and control, emissions trading or a combination of these two approaches—can be selected for each source category. Where some form of emissions trading is to be implemented, a comprehensive permit system is highly desirable. However, the introduction of the trading program (or other regulatory measures) need not be delayed until the complete inventory is available and the permit system in place. Trading can begin, provided that trades are restricted to permitted sources and that before any unpermitted or uncontrolled source is allowed to be traded, an appropriate baseline is defined for that source. The trading program can be used to draw unregulated sources into the control program. Title IV of the Clean Air Act amendments applies SO_2 allowance trading only to fossil fuel electric-generating stations, but allows other sources of SO_2 emissions to opt in.

EFFICIENT AND PREDICTABLE ADMINISTRATION

High on the list of factors that will discourage a businessperson from siting in an area is uncertainty about how the regulator treats environmental permit applications. If an emissions trading system is in place, businesses must know that their offset-related applications will be quickly and effectively processed.

A charge that is often levied at the SCAQMD is that ERC applications can take up to year to process. ERC transfers can take a similar amount of time, though most are disposed of within six months. Industry believes that the district rarely acts within the prescribed periods for processing or transferring ERC applications.

There is also significant uncertainty as to the rules that govern ERCs. Since 1976 the SCAQMD emissions trading rules have gone through at least six significant modifications. In addition, there are numerous policies that affect how ERCs are processed, granted, and used. These policies, which are generally known only to certain SCAQMD personnel and to persistent players, are often changed as well.

Clear and unchanging rules, consistent decisions, predictable time requirements, and adherence to the timelines and schedules prescribed in the regulations will contribute to the success of an emissions trading program. Prompt, efficient, simple, low-cost administration of the program is preferable, but predictable and consistent administration is essential.

EFFECTIVE EMISSIONS BANK

An emissions banking program will greatly contribute to the success of an emissions trading program. An emissions bank is an administrative mechanism that allows sources to create emission reductions, gain recognition for them, and store them for later use or sale. All the California programs described in

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[32] The acid rain provisions of the 1990 Clean Air Act amendments include provisions for continuous emissions monitoring linked to a computerized database. These provisions will lead to an unprecedented level of monitoring and reporting.

Chapter III, together with the New Jersey and the Jefferson County, Kentucky, programs, have emissions banks.

Having a safe place to put ERCs or allowances once they are created will do several things: (1) it provides industry with the confidence that ERCs created as the result of voluntary efforts can be stored for later use if an immediate use cannot be found for them, (2) it provides potential users or buyers with a means to identify the emission reductions that have gained the mantle of ERC certification, (3) it contributes to the fluidity of the market, as buyers are more willing to expend funds on a commodity that has already been certified, and (4) it alleviates concern that ERCs or allowances will be confiscated by regulators anxious to meet their air quality planning objectives.[33]

The value of an emissions bank in a trading program is highlighted by the SJCAPCD program. Prior to the adoption of the SJCAPCD bank in 1987, there were no offset trades and few sources voluntarily created emission reductions. After 1987, over 1,549 tons of ERCs were sold through 12 offset trades. This level compares favorably with the SCAQMD, in which about 4,101 tons per year of ERCs have been traded through 91 offset trades between 1987 and 1990, given that the SCAQMD has a population that is 25 times greater than that of the SJCAPCD.[34]

To be effective, an emissions banking program must have the following characteristics: a clear application process, a predictable ERC review process, a long shelf-life for ERCs, protection from the discounting associated with rules that are passed after an ERC is created, protection from confiscation, and an understandable transfer process. Failure to include these elements in an emissions bank will reduce industry's willingness to participate in an emissions trading program.

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[33] It should be noted that ERCs can still be confiscated under SCAQMD rules. SJCAPCD, SJVUAPCD and BAAQMD rules make it somewhat more difficult to confiscate ERCs. New Jersey rules provide little or no confiscation protection.

[34] Louis Chu, Planner, San Joaquin County Air Pollution Control District, stated in an August 23, 1991, telephone call that the population in San Joaquin County is about 479,000. *Air Quality Management Plan, South Coast Air Basin* (March 1989), pp. 1-7, indicates that the population in the South Coast Air Basin was about 12 million in 1990.

SELF-SUPPORTING

If an emissions trading program is to work, it must be self-supporting. A program that lacks the resources for proper implementation will fail regardless of how elegant its design, well intentioned its regulators or enthusiastic its industry users.

An emissions trading program should levy appropriate fees on those that wish to file for, create, bank, and use ERCs. Failure to set these fees at levels that allow the regulators to do their job will contribute to delays and reduce the quality of reviews. When a regulator is short of funds, problems with immediate deadlines will always take precedence over those that are less urgent. Because seeking ERCs falls outside the realm of crisis projects, the regulator will inevitably "back-burner" ERC applications in favor of permit applications.

Additionally, the regulatory body with jurisdiction should have the ability to use the fee revenue to hire staff and support the ongoing activities of the trading program. Such fees should not go into a general fund either within the regulatory body or the government in general.

The SJCAPCD charged base and hourly fees to process ERC-related transactions, and staff activities were supported by the charges. The SCAQMD, on the other hand, has suffered from a lack of resources in implementing its emissions trading programs. Engineers responsible for ERC reviews are routinely pulled off these projects to process permits. Trading programs in other states, especially Massachusetts, have failed to get off the ground because the funding mechanism is not set up to allow the regulator to levy fees that will go to hire the staff who will process ERC-related transactions.

TRADING PROGRAM AND AIR QUALITY PROGRAM UNDER THE CONTROL OF ONE ENTITY

The administration of both the air quality rules and the emissions trading program should be under the common control of a single regulatory entity. The existence of multiple agencies with different levels of control can result in the implementation of programs with conflicting goals, an unevenly applied permitting and offset program, and exemptions for significant air pollution contributors.

One reason why California's air quality problem has persisted so long is that major categories of emissions were exempt from the control of those responsible for air quality. Indirect sources (e.g., those that attract vehicular traffic) and areawide sources (e.g., those who use small quantities of paint) have fallen outside the scope most air quality programs. Industry leaders and program administrators became more and more frustrated as emission controls got ever more stringent on industry, but pollution levels remained high. The high pollution levels were caused, at least in part, by the magnitude of the emissions contributed by excluded sources.

California programs are taking steps to bring excluded sources under the control of the air regulators. Dropping the emission offset thresholds to zero was the first step. The likely adoption of indirect and areawide source control rules that will require, among other things, the acquisition of offsets by these sources is another step.

The failure to account for the contribution of exempt sources and the inability to control their emissions will frustrate an emissions trading program whose goal is to achieve an overall reduction in emissions.

EMISSIONS TRADING PROGRAM LOCATED IN AN AREA WITH ECONOMIC GROWTH

An emissions trading program, especially one that is focused on offsetting emissions from new sources, will thrive if economic growth in the area is strong. Businesses that wish to site in the area or those that wish to expand will be faced with the need to secure offsets. In the absence of economic growth, there will be relatively little demand for emission offsets.

Such is the case in New Jersey where, despite the existence of an emissions bank with thousands of tons of ERCs, only a half-dozen transactions have taken place in the last decade (the high offset threshold has undoubtedly also dampened offset demand). However, despite its stringent air quality command-and-control requirements, there have been over 100 offset transactions is the SCAQMD in the last decade and over 12 offset transactions in the SJCAPCD since only 1988.

Economic growth is also important for allowance and attainment-based emissions trading programs. New sources contribute to allowance demand and increase the marketability of the allowances that can be sold. However, it should be noted, that economic growth is not as critical for attainment-based programs as it is for new-source offsetting programs. Demand for allowances is less influenced by economic growth than the magnitude of the annual emission reduction target and the breadth of the allowance-trading program.

PROGRAM CHAMPIONS NEEDED WITHIN AND OUTSIDE THE REGULATORY AGENCY

An emissions trading program will only be successful if it has champions that support its goals within the entity that develops the implementing legislation and the regulatory body that must develop supporting rules and implement the program.

Developing and implementing an emissions trading program is generally a departure from the status quo, which is usually a command-and-control approach. It generally requires regulatory bodies to step back from the micromanagement of industrial operations and pollution control methods and adopt a more goal-oriented approach to pollution control. Because regulators and the regulated have traditionally found themselves in adversarial positions, it is sometimes difficult for regulators to embrace a strategy that relies on the regulated to make prudent decisions regarding control strategies—even where severe sanctions are in place to penalize those who miss their goals.

An emissions trading program will never be developed if there is not a champion within the body that is responsible for developing the implementing rules. The champion must seize on the problems of the traditional regulatory strategies and the benefits of emissions trading to convince his or her colleagues that emissions trading provides enough promise to warrant a departure from a strict command-and-control approach.

Once the emissions trading program is in place, the champion within the regulatory agency must convince staff that industry, given proper incentives, will accomplish the air quality goals without extraordinary micromanagement by the agency. It must be made clear to staff that their roles are to ensure that industry meets the prescribed goals, to educate industry and the public on the benefits and mechanics of emissions trading, and to bring enforcement action against those that fail to comply. Staff must also know that senior management will support their efforts to implement the emissions trading program.

The SJCAPCD was one case where a champion internal to the agency played a critical role in the development and implementation of the emissions trading program. The SJCAPCD champion clearly made a difference in the regulatory agency's willingness to work with industry and the public to develop the regulations. The champion's continued support has allowed the SJCAPCD to run perhaps the most effective and active trading program in the nation (if trades per capita is used as the measure of activity).

PROGRAM DEVELOPED WITH ACTIVE INPUT OF ALL STAKEHOLDERS

The emissions trading program must have the support of those that will be affected by it. Failure to gain this support will likely result in a system, no matter how well designed, that is either unused, fails to accomplish its goals, or does not serve its intended users.

Stakeholders of concern include those within the legislature, the regulatory agency, industry, and the public. Those within the legislature develop the laws that provide for emissions trading and must ensure that the emissions trading program does not thwart larger goals (e.g., reducing basinwide emissions). Those within the regulatory agency must manage the development and implementation of the emissions trading program. They are charged with meeting the legislated goals. They must also ensure that they either build the program around their resources and capabilities or secure the needed resources and capabilities to implement the program. Industry must be involved to ensure that the program is workable and presents a desired alternative to simple command and control. And the public must be involved to ensure that there are avenues for monitoring major decisions that are made as a result of the program.

The SJCAPCD, in the development of its emissions banking program, and the SCAQMD, in the conceptualization of its marketable permits program, serve as good examples of how stakeholders can play a significant role in the development of an emissions trading program.

VI. THE FEASIBILITY OF NO_x & VOC TRADING IN THE LOWER FRASER VALLEY

THE NEED FOR NO_x AND VOC CONTROL

Low-level ozone concentrations in the Lower Fraser Valley sometimes exceed the federal government's Maximum Acceptable Objective for one-hour average concentrations. Excessive concentrations of low-level ozone are a seasonal problem; the highest concentrations occur from March to September. Some types of weather conditions give rise to ozone episodes in which the Maximum Acceptable Objective is exceeded. In most years, there are fewer than ten such episodes.

To reduce ozone concentrations, it is necessary to control emissions of the gases from which ozone is formed in the atmosphere: nitrogen oxides (NO_x) and volatile organic compounds (VOCs).

SOURCES OF NO_x AND VOCS IN THE LOWER FRASER VALLEY

Mobile sources, primarily motor vehicles, are responsible for over 60% of VOC emissions and over 75% of NO_x emissions. Point sources, such as manufacturing facilities, are the source of 9% of the VOC emissions and over 15% of the NO_x emissions. Area sources—small or diffuse sources (e.g., residential space heating), small commercial facilities (e.g., dry cleaners and auto body shops), and fugitive emissions from landfills—supply over 20% of the VOC emissions and about 5% of the NO_x emissions. Gasoline marketing accounts for almost 80% of the VOC emissions.

Point source emissions of NO_x and VOCs are forecast to increase by 84% and 39%, respectively, to the year 2005. Mobile source emissions of NO_x and VOCs are forecast to decrease by approximately 7% and 37%, respectively, during this period. Mobile sources will remain the dominant source of NO_x and VOC emissions.

SCOPE OF THE TRADING PROGRAM

This assessment is limited to the feasibility of emissions trading among point sources of NO_x and VOCs in the Lower Fraser Valley. Mobile and area sources of NO_x are excluded, as are mobile, area, and gasoline marketing sources of VOCs. Point sources are the exclusive focus of this assessment because they are generally more amenable to a trading program option.

It is essential to understand that an emissions trading program for point sources cannot achieve the air quality objectives for the Lower Fraser Valley by itself. Point sources are responsible for less than 15% of VOC emissions and less than 25% of NO_x emissions. Even if all point source emissions were eliminated, it would not achieve the air quality objective. The emissions trading program for point sources must be complemented by other initiatives that reduce mobile source emissions for NO_x and VOCs substantially.

EMISSION REDUCTION OBJECTIVES

The Board of Directors of the Greater Vancouver Regional District (GVRD) is to reduce total emissions of sulphur and nitrogen oxides, particulates, carbon monoxide and volatile organic compounds by 50% by the year 2000. The NO_x/VOC Management Plan that the Canadian Council of Ministers of the Environment adopted calls for 40% reductions in the 1985 emissions of both NO_x and VOCs by 2005 in Phase I. It recognizes that further reductions may be needed to achieve the air quality objective for low-level ozone in the Lower Fraser Valley.

The precise targets for NO_x and VOC emission reductions are not critical to the feasibility assessment, although they should be established as part of the program design process. We assume that the air management plan implemented to achieve the NO_x and VOC emissions reductions will seek to achieve roughly proportional reductions across all source categories: for example, 40% reductions of NO_x and VOC emissions from point sources, mobile sources, area sources and gasoline and marketing sources. We assume that the emissions reductions for mobile, area and gasoline marketing sources will be achieved through conventional command-and-control measures.

IMPLEMENTATION AUTHORITY

Most, but not all, of the Lower Fraser Valley falls within the jurisdiction of the GVRD, which administers air quality on behalf of the British Columbia Ministry of Environment. If an emissions trading program were to be instituted in the Lower Fraser Valley, it could initially be implemented in the GVRD and later extended to the remainder of the region through action by the Ministry of Environment.

A summary of the feasibility of implementing an emissions trading program for point sources of NO_x and VOC in the GVRD's jurisdiction within the Lower Fraser Valley is provided below. A more detailed analysis is provided in Appendix G.

FEASIBILITY OF EMISSIONS TRADING IN THE LOWER FRASER VALLEY

The U.S. emissions trading experience has shown that emissions trading can work. Analyses of trading programs in the United States confirm that emissions trading has realized cost savings. However, emissions trading has been more effective in some circumstances than others. The recent creation of a tradeable SO_2 allowance system as part of the 1990 Clean Air Act amendments is evidence that the United States' continues to have faith in the efficacy of emissions trading.

However, to determine whether emissions trading is feasible and desirable in the Lower Fraser Valley, two issues must be considered: the potential for economic benefit from the implementation of emissions trading in the Lower Fraser Valley and the potential for a reasonably competitive market with adequate numbers of buyers and sellers. These issues are considered below.

Potential for Economic Benefit

Emissions trading can yield economic savings by better matching needed reductions to the air quality target, by allowing a wider range of compliance strategies and by facilitating adoption of the lowest cost strategies.

Better Matching of Emissions with Needs

A command-and-control approach would not be the most efficient means to achieving air quality goals for the Lower Fraser Valley because it would require all, or selected, sources to implement a proven control technology. The installation of proven NO_x and VOC control technologies would reduce emissions to levels significantly in excess of the percentage reduction targets.[35] However, because the reductions achieved through the installation of these control technologies by all sources would exceed the reductions required, control costs would be higher than necessary. A system that only required selected sources to install controls would be inequitable. Consequently, a command-and-control approach is not the most cost-effective means for achieving local air quality goals.

An emissions trading program, on the other hand, allows a better match between the reductions implemented and the target reductions. Consequently, compliance costs are reduced. Emission savings in excess of requirements by one source can be sold to another source, potentially eliminating the need for the second source to install additional controls. Purchasing emission allowances could be a lower cost option for a firm than installing controls. Furthermore, the purchase of excess emission reductions would partially reimburse the seller for the costs of the emission control equipment.

Wider Range of Compliance Options

The second source of economic benefits available from an emissions trading system is the ability to employ a wider range of potential control options with a wider range of costs. A command-and-control approach typically focuses on control technologies. With emissions trading, any technique that reduces emissions can be used. For example, VOC emissions can be cut by switching to different solvents or coating formulations. Reductions achieved by such means generate savings that can be sold to other sources and are implemented even if they cost less than the probable revenue received from the sale. With a command-and-control approach, there is no incentive to implement measures other than those mandated.

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[35] See Appendix G for detail to illustrate this point.

The costs of emissions reduction measures for NO_x and VOCs range from hundreds of dollars per tonne to tens of thousands of dollars per tonne. With such a wide range, there is a strong incentive for sources with the opportunity to implement low-cost measures to do so and to sell their surplus allowances to sources facing higher cost alternatives. Both sources benefit from the resulting trade. The seller earns a profit on its excess control initiatives. The buyer has reduced the cost of compliance relative to the other options available. There is an overall cost savings because an emissions trading program would implement the lowest cost reduction methods.

Would a Few Firms Dominate the Market?

The GVRD's 1985 emissions inventory lists 351 point sources in the Lower Mainland. Approximately 195 of the point sources contribute NO_x emissions, and approximately 198 contribute VOC emissions. However, the majority of emissions come from a limited number of sources. Six large sources, two cement plants and four refineries, are responsible for over 60% of total NO_x emissions. Four of those sources, the refineries, also account for approximately 70% of total VOC emissions. The distribution of emissions by size of source is shown in Figure 1. One large source of NO_x emissions, BC Hydro's Burrard Generating Station, is not reflected in the above data because it was not operating during 1985 when the emissions inventory was completed.

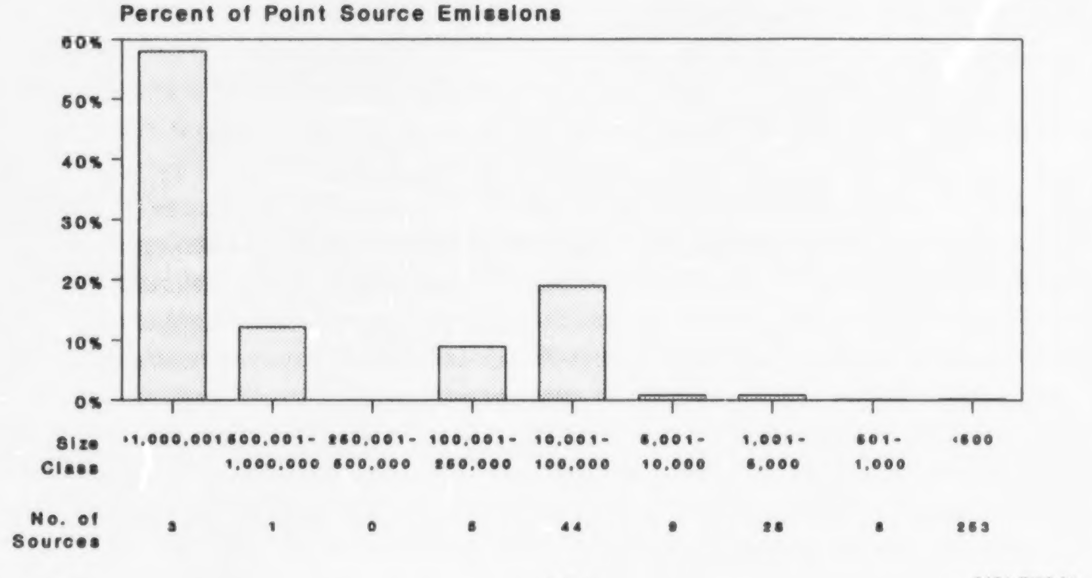
To reduce point source emissions of NO_x and VOCs by 40% or more, at least half the large sources will have to take action. This is true whether a command-and-control or an emissions trading approach is used. That these sources will have to take action raises the possibility that a few large firms will dominate the market if a trading system is adopted.

It is difficult to draw firm conclusions concerning the competitiveness of the market before the market is created. However, some guidance is available from measures of market concentration used for other purposes.

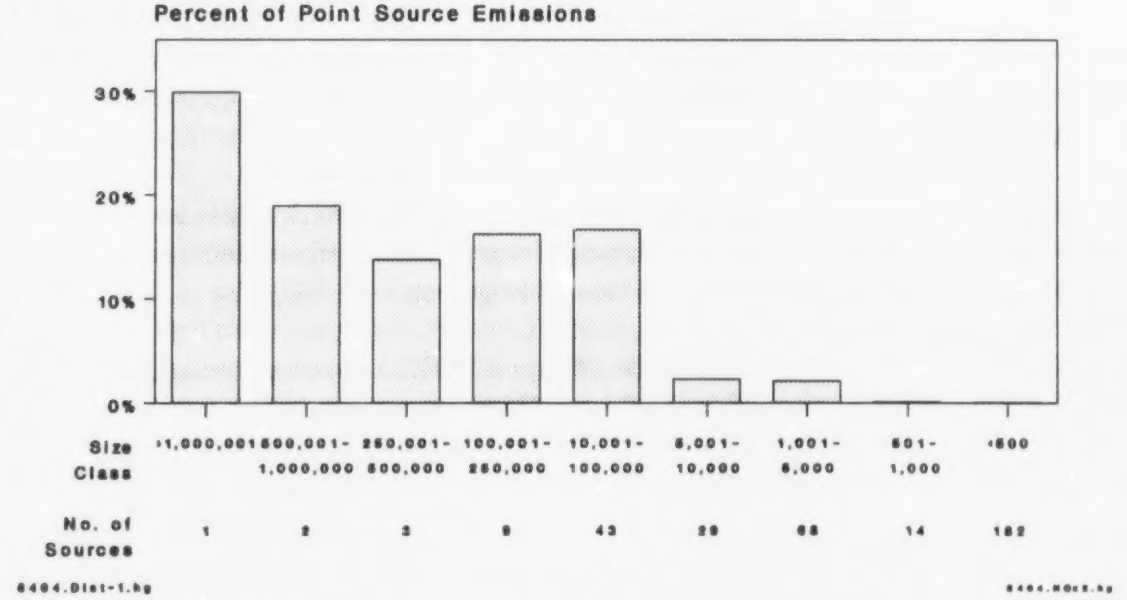
The four-firm concentration ratios for the NO_x and VOC allowances markets in the Lower Fraser Valley would be 53.6% and 70.2%, respectively, based on the 1985 inventory. The NO_x market falls into the moderately concentrated category and the VOC market is borderline highly concentrated according to the criteria

Figure I
Distribution of NO and VOC Emissions by Size of Source

VOC



NO_x



used by the U.S. Department of Justice.[36] The fact that some of the same firms are among the largest in each market does not change the situation appreciably.

Clearly, the proportion of emissions (hence, allowances or credits among the largest firms) is such that concern about possible noncompetitive behavior is valid. However, the concentration is not so high as to be alarming. Smaller sources would need smaller quantities of allowances if they are buyers, and these could be supplied by other small sources. Thus, the small sources would not be captive buyers or sellers for the large sources.

More germane in the possibility of incorporating measures into the trading program that would prevent those firms from exercising their market power. Such trading program can be designed. The SO_2 allowance trading program in the United States includes such provisions. Specifically, it withholds a small fraction (2.8%) of the allowances allocated to each source and sells these allowances directly and by auction; the proceeds are distributed to the sources from which the allowances were withheld. In effect, every source is forced to become a seller of a small fraction of its allowances. In our judgment, allowance trading programs with provisions of this sort are feasible for the Lower Fraser Valley.

Options for Trading Program

Two options for the design of an NO_x or VOC trading program are provided. They are based on the emissions reduction credits and allowance trading programs found in the United States. Each option is discussed in turn.

Emission Reduction Credit Program

With an emission reduction credit program, the emissions reductions are achieved primarily through command-and-control measures imposed on existing, modified and new sources. Netting and bubble provisions facilitate compliance by existing sources. Emission reduction credits are created and traded primarily to facilitate economic growth, which leads to the expansion of existing sources or establishment of new sources.

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[36] U.S. Department of Justice, Antitrust Division, *U.S. Department of Justice Merger Guidelines* (Washington, D.C., June 14, 1984), pp. 13-14.

Under this option, the GVRD would mandate emission reduction and control measures for all existing, modified and new point sources. The measures would be chosen to achieve the target reductions in NO_x and VOC emissions.

If, after implementing all mandated reduction and control measures, some new and modified sources exceed the established threshold, they would purchase emission reduction credits from existing sources (directly or indirectly via the emissions bank) to at least offset their residual emissions. The specific threshold level, offset requirement and any geographic restrictions on the source of the credits would be established by policy.

The buyers would be new point sources and expanded old point sources whose emissions exceed the specific threshold. The sellers would be existing point sources that have reduced their emissions beyond the required level. With opt-in provisions, nonpoint sources could also become sellers.

Tradeable Allowance Program

Under a tradeable allowance approach, each point source would be allocated allowances in proportion to its historical emissions level (or on the basis of some other agreed-on formula). An allowance would represent one unit (e.g., one tonne) of NO_x or VOC, which could be emitted at any future date. The total quantity of allowances issued each year would decline gradually to the target quantity (e.g., 40% less than the 1985 level) in 2005. Each source would be required to provide the GVRD with allowances equal to the actual emissions it reports quarterly or annually.

Because the total quantity of allowances issued would be less than the total emissions in the base year, there will not be enough allowances to enable all sources to comply by using allowances. Some sources will have to implement measures to reduce their emissions. These sources would probably implement measures that reduce total emissions below the quantity of allowances held because their future allocations of allowances would be lower still. The surplus allowances could be banked for future use or be sold to other point sources in need of emission reductions.

Although we assume that no additional command-and-control requirements would be imposed on point sources under a tradeable allowances program, that need not be the case. Mandated controls are not needed for a tradeable allowances program and reduce the potential economic savings from trading. However, they are not incompatible with an allowance trading system. To the extent that more stringent controls are imposed on each source, the source has less discretion in choosing a control option and therefore less incentive and opportunity to trade.

Comparison of the Emissions Trading Options

We conclude that either an emissions reduction credit or an allowance trading system is feasible for both NO_x and VOCs in the Lower Fraser Valley.

An emission reduction credit trading program can be effective if the primary goal is to facilitate economic growth in the region while maintaining air quality. Improvements in air quality could be achieved primarily through command-and-control measures. Netting and bubble provisions could reduce the costs of compliance for existing sources. Offset provisions allow for new sources and the expansion of existing sources in the region without a deterioration of air quality.

With an emission reduction credit trading program, the buyers are new or modified sources whose emissions exceed the threshold level. Experience has shown that low thresholds increases the number of potential buyers. Any existing source can, in principle, create emission reduction credits and become a seller. Opt-in provisions offer the potential to increase the number of sellers. The high percentage of emissions resulting from only a handful of point sources should not be a problem. Lack of competition has not been a problem in any of the U.S. jurisdictions studied, even when the number of trades has been small. In short, an emissions reduction credit trading program can realize some benefits, but they are not as large, and are not intended to be as large, as the economic benefits associated with an allowance trading program.

Allowance trading is a more radical change; it substitutes trading for command-and-control prescriptions as the primary means of achieving air quality improvements. Although it does not preclude additional command-and-control measures, the more restrictive these measures are, the lower the benefits of the trading program.

Due to its flexibility and its mandatory participation, an allowance trading program provides greater opportunity for trading activity. Consequently, it also offers a greater opportunity for significant cost savings. However, if an allowance trading system is adopted, it is more important that it include provisions to ensure that a competitive market for allowances is maintained. Otherwise, the larger players would have the opportunity to exert excessive control. A zero revenue auction, where allowances are withheld and sold at auction by the regulatory agency with the proceeds distributed to the emissions sources, is an effective way of maintaining a competitive market.

IMPLEMENTATION RECOMMENDATIONS

If emissions trading is implemented in the Lower Fraser Valley for NO_x and/or VOCs (or other pollutants), we recommend that the GVRD and the Ministry of Environment do the following:

- Define the goals of the program clearly. With clear goals, it is easier to design the program well and to evaluate its performance subsequently.

- Base the program on a quality emissions inventory. An inventory that covers all point sources in the Lower Fraser Valley is about to be prepared for 1990. Every effort should be made to ensure that it is accurate. If it is to be used as the basis for a trading program, point sources should have an opportunity to verify their emissions.

- Review the program's permit system to ensure that it meets the needs of the trading program. All point sources within the GVRD already require permits. Point sources in other parts of the Lower Fraser Valley require permits from the Ministry of Environment. However, the reporting requirements or other provisions may need to be modified to support the trading program.

- Ensure that emissions trading has the support of stakeholders and the public. Explain the program and the reasons for its adoption to the stakeholders and the public.

- Bring emissions trading and air quality in the Lower Fraser Valley under the control of a single administration. Although the majority of point sources are located within the GVRD, air quality administration and emissions trading should treat the Lower Fraser Valley as a single region. To do this, the GVRD and the ministry should establish identical requirements for the Lower Fraser Valley and allow trades across jurisdictions. Alternatively, air quality management in the entire Lower Fraser Valley could be given to the GVRD.

VII. EVALUATING THE EFFECTIVENESS OF AN EMISSION TRADING PROGRAM

This chapter discusses issues involved in the evaluation of an emission trading program. The discussion is intended to assist in developing an evaluation plan for an emissions trading program in the Lower Fraser Valley, should one be implemented. Chapter VI outlines two options for emissions trading in the Lower Fraser Valley. They are:

- An emissions reduction credit system
- An allowance trading system

There are fundamental differences between these trading systems that affect the manner in which they are evaluated.

This chapter addresses the evaluation of both types of trading programs and distinguishes between the two where it is important to do so. The options are defined in conceptual terms, leaving many details to be resolved through discussions with stakeholders and through policy decisions. The following discussion of the issues involved in evaluating the effectiveness of these potential emissions trading programs is of a similarly conceptual nature. Once a specific emissions trading program has been adopted, a detailed evaluation plan for that program should be developed.

Evaluations of program effectiveness generally address either or both of the following categories of issues:

- Achievement of the program's objectives
- Delivery of the program

Assessment of the extent to which the implicit and explicit objectives of a program have been achieved is usually called an impact evaluation. Assessment of the effectiveness of the delivery of a program is called a process evaluation. A thorough evaluation of an emissions trading program would involve both an impact evaluation and a process evaluation.

IMPACT EVALUATION

An impact evaluation of an emissions trading program focuses on how well the program meets its implicit and explicit objectives. Often this assessment involves comparisons with alternatives that have not been adopted and so can only be estimated.

Emissions trading is part of a strategy to achieve an air quality objective. The role of emissions trading in reaching that objective is often, but not always, explicit. As noted in the case studies, the most common objective of emissions trading programs has been to protect environmental quality while accommodating economic growth in nonattainment areas. Allowance trading programs have generally been designed to help achieve a specified reduction in emissions.

The goals of the emissions reduction credit and allowance trading program options differ principally in terms of the contributions the trading program is expected to make to:

- Achievement of the air quality goal
- Accommodation of economic growth

Because of the different roles proposed for these programs, the effectiveness of allowance and emissions reduction credit trading programs must be evaluated differently.

Achievement of Air Quality Goals

The allowance trading option is designed to help achieve an air quality objective in the Lower Fraser Valley. Hence, a fundamental measure of the success of the allowance trading program would be the extent to which the air quality goal has been achieved. It should be kept in mind, however, that the allowance trading program is intended to apply only to point sources and that these sources account for less than 25% of total NO_x and VOC emissions. The allowance trading program could be effective in reducing emissions by point sources to their target levels while the overall air quality goals might not be met because the command-and-control measures applied to other source categories are not as effective as anticipated.

The emissions reduction credit option is designed to protect air quality while accommodating economic growth in the Lower Fraser Valley. A range of command-and-control policies would be implemented to achieve the air quality objective. In an emissions reduction credit program, it may be easier to evaluate the effectiveness of the program components separately; the offset, netting, banking and bubble components contribute in different ways to the overall program goal.

Offsets require reductions in emissions from existing sources that equal or exceed the increased emissions due to new sources or the expansion of existing sources. New and expanded sources are only required to acquire offsets if their emissions exceed the threshold level. The recommended program design features zero thresholds, so all growth in emissions would be covered by the offset requirements. Netting allows a firm with multiple sources that is implementing modifications to its facilities to comply with the command-and-control requirements in aggregate rather than on a source-by-source basis. Bubbles, if permitted, enable multiple sources to comply in aggregate rather than source by source. Banking is a mechanism for facilitating trades of emissions reduction credits and, in itself, should have no impact on air quality.

Achievement of the air quality goal is one of the fundamental measures of the effectiveness of an emissions trading program. The role of an allowance trading program is to help achieve the air quality goal, so the goal is clearly an appropriate measure of the program's effectiveness. The role of an emissions reduction credit trading program is to accommodate economic growth while preserving air quality, so achievement of the air quality goal establishes a context for measuring its success. In either case, the trading program will only apply to point sources, which account for less than 25% of total emissions, so failure to achieve the air quality goal may be due to other source categories, not the trading program.

It has been claimed that the flexibility and lower costs associated with emissions trading programs (compared with command-and-control approaches) have allowed more ambitious air quality goals to be established and enabled air quality goals to be achieved more quickly. These dimensions of air quality improvement are important aspects of the evaluation of the emissions trading program. They are relatively more important for the allowance trading option but also apply to the emissions reduction credit option. Conclusive evidence on these aspects of the emissions trading program may be difficult to compile.

Accommodation of Economic Growth

The degree to which the emissions trading program has accommodated economic growth is a second indicator of its success. For an emissions reduction credit trading program, the objective is to accommodate economic growth while protecting air quality, so economic growth is obviously a critical measure of the program's effectiveness. It remains an important indicator of the success of an allowance trading program, where the objective is to achieve a specified standard of air quality. An allowance trading program that achieves the air quality goal but stifles economic growth is less effective than one that facilitates economic growth and also achieves the air quality goal.

With an emissions reduction credit trading program, it may be easier to evaluate the effectiveness of the individual program components. Offsets must be acquired by new sources and expanding existing sources whose net emissions exceed the specified threshold. In the absence of the offset provisions, those new sources and expanding existing sources could not legally locate in the region. Netting allows existing sources to comply with regulations and expand more quickly and at lower cost because the regulatory requirements are simpler. Bubbles, if permitted, allow multiple sources to comply at lower cost. A banking program may make the acquisition of emissions reduction credits quicker and easier and, in this way, can help accommodate economic growth.

Measuring the success of an emissions trading program in accommodating economic growth is difficult. It is possible to observe the economic growth that has occurred under the program, but it is not possible to observe the growth that would have occurred in the absence of the program. Some other form of emissions control must be assumed in the absence of the emissions trading program, and the economic growth under that set of emissions controls must be estimated. It may be possible to use economic models or other means to estimate the impact of the emissions trading program on economic growth, but it will never be possible to get precise data on this aspect of the performance of the emissions trading program.

With an emissions reduction credit trading program, it can be argued that no new sources or expansions of existing sources that have emissions above threshold levels would be permitted in the region in the absence of the trading program. In this case, all sources participating in the offset program represent economic growth that could not have occurred otherwise.

Compliance Cost Savings

One of the strong arguments in favour of an emissions trading system is that it is a less costly means of achieving a specified environmental objective than conventional command-and-control approaches. Thus, compliance cost savings is an implicit objective of an emissions trading program. The cost savings achieved are another important indicator of the effectiveness of an emissions trading program. The actual costs of the control measures that would have been adopted in the absence of the emissions trading program cannot be observed; they can only be estimated. These costs are another aspect of the effectiveness of an emissions trading program that cannot be measured precisely.

In the case of an allowance trading program, the ability to achieve the target reduction in emissions at lower cost is a key argument in favour of the program. To evaluate the cost savings achieved, it is necessary to estimate the cost of the lowest cost alternative for each source.[37] Knowledgeable analysts can make this estimate after the fact, but it is an expensive exercise and is prone to error. A more accurate and less costly evaluation can be performed if information on the lowest cost alternative is collected as the program is being administered. Buyers of allowances can be asked to identify what they considered to be their next best alternative. Sellers of allowances can be asked if they would choose a different option if it were not possible to sell the surplus allowances. Of course not all buyers and sellers will be able or willing to answer these questions, but the responses received will reduce the work required of the program evaluators.

With an emissions reduction credit trading program, the cost savings can most accurately be measured by component. Netting and bubbles allow an existing source to comply with the regulations at a lower cost. The alternative compliance options can usually be determined from the regulations. The actual compliance cost can be compared with the estimated cost of the alternative. Sources that purchase offsets do not realize any savings on their emissions control equipment and they must incur the cost of purchasing the offsets. However, because these are all new sources or significant expansions of existing sources they have a choice of other locations. Their decision to locate in the region and to incur its attendant compliance costs suggests that their next-best location is more expensive overall or has other disadvantages that outweigh the cost savings.

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[37] This discussion assumes that in the absence of the allowance trading program, sources would need to achieve the same reductions in their emissions by other means. It is also possible to define a set of command and control measures as the alternative and use that presumed regulatory framework to estimate compliance costs in the absence of the trading program.

Other Impacts of Emission Trading Programs

Other advantages claimed for emissions trading programs include:

- Promotion of innovative technology
- Participation of a larger number of sources in the regulatory program

These are also implicit objectives of an emissions trading program and can therefore be used as indicators of the effectiveness of the program.

It can also be argued that the degree of compliance is different for an emissions trading program compared to command-and-control regulation. Higher or lower compliance levels can be hypothesized for the trading programs. To the extent that differences in compliance levels are believed to occur, they represent an impact of the program that should be evaluated.

The above discussion indicates that a clear statement of the objectives of the emissions trading program will make it easier to evaluate its effectiveness. Plausible implicit objectives need to be accepted or rejected. In the absence of a clear statement of the objectives, the program evaluators will have to infer what they were, and they may draw the wrong conclusions.

PROCESS EVALUATION

A process evaluation of an emissions trading program focuses on how well the program is being administered. Possible measures of the effectiveness of the administration of an emissions trading program include:

- Volume of trading activity
- Time lags for executing trades
- Percent of proposed trades approved
- Costs of trading
- Costs of enforcement

- Market behaviour
- Frequency of revision of the rules

Trading Activity

Perhaps the most basic indicator of process efficiency is trading activity. If there are no trades, the theoretical advantages of emissions trading are not being realized. Trading activity can be measured by the number of sources that participate and the volume of emissions allowances traded. However, in the case of an emissions reduction credit trading program, a lack of trading activity is not necessarily an indicator of program failure.

A lack of trades suggests a need for further analysis. In an allowance trading program a lack of trades may indicate that other regulations leave little flexibility for compliance and hence little scope for trading. Sparse trading activity in an allowance trading system may also indicate that a few large sources are able to dominate the market. In an emissions reduction credit trading program, a lack of offset trades may be due to high threshold levels. Alternatively, a lack of offset trades may simply reflect a lack of economic growth in the region. A low level of netting trades in an emissions reduction credit trading program may indicate that the approvals process is too cumbersome or that the savings relative to the command-and-control regulations are small. In any case, trading activity serves more as an indicator of the need for further investigation than as a measure of the success of the program.

The Trading Process

The relevance of the other measures of process effectiveness is self-evident. Long time lags for executing trades suggest that the approvals process is cumbersome or that insufficient staff and resources are available to process proposed trades. The percent of proposed trades approved is a crude indicator of whether the rules are explicit. Clear rules for the most common types of trades will lead to a high percentage of approvals. A low approval percentage suggests either that the rules are not as clear as they should be or the capricious use of discretionary authority.

Trading and Enforcement Costs

An applicant's cost to transact a trade will influence the volume of trading. Processing fees are usually only a small part of this cost. Consulting fees, legal costs and the other costs of preparing documents needed to support a transaction can be high. Simplifying the trading process will tend to reduce the transaction costs and promote trading. The total cost of trading—all the costs associated with preparing the necessary documents, processing and other fees, as well as costs due to delays—is a good indicator of the effectiveness of the administration of the trading program.

The enforcement costs to the regulator and the regulated are another good measure of the effectiveness of the administration of the trading program. Are the monitoring and reporting costs imposed on emissions sources unnecessarily high? Are inspection and enforcement expenditures by the regulatory agency too high? The total cost of ensuring that the program is reasonably enforced is an appropriate issue for the process evaluation.

Market Behaviour

The behaviour of the market for tradeable allowances or emissions reduction credits can also provide an indication of how well the program is administered. Wide fluctuations in prices over time or space suggest that the market may not be functioning smoothly. Some of the fluctuations may be due to regulatory or administrative decisions that limit the ability to trade or otherwise affect the market.

The market may also be affected by hoarding or noncompetitive behaviour by larger firms. Hoarding, that is, a reluctance to sell, may indicate high transaction costs or a high degree of uncertainty concerning future requirements. Noncompetitive behaviour by larger firms may involve hoarding or attempts to distort prices by other means. Evidence of hoarding or noncompetitive behaviour is an indicator that there may be problems with the administration of the trading program.

The regulatory authority can also affect market behaviour. In the case of emission reduction credits the regulatory authority can affect the liquidity of the market. If a credit owner's rights are not secure, fewer credits will be created. The offset ratio is another regulatory distortion of the market. The provisions by which regulators will withhold and sell SO_2 allowances are an attempt to ensure that the market will have an opportunity to function smoothly. Thus, a market that is not functioning well may also be evidence of deficiencies in the administration of the trading program.

Frequency of Rule Changes

A history of frequent rule changes makes a trading program less attractive to potential participants. It becomes more difficult and costly to keep abreast of the trading rules and this lowers trading activity. Of course, the air quality administrators may not be fully in control of the frequency of rule changes. Provincial or federal government actions may force rule changes on the local air quality administrators. A new trading program will also encounter some teething problems, and it is usually better to correct these problems than to let them persist out of a reluctance to change the rules.

SUMMARY

An evaluation of the effectiveness of a program usually includes an assessment of either or both the extent to which the objectives have been achieved (impact evaluation) and how well the program has been delivered (process evaluation).

This report has outlined an emissions reduction credit program and an allowance trading program for NO_x and VOC emissions in the Lower Fraser Valley in conceptual terms. The issues involved in conducting impact and process evaluations for these trading programs are also discussed in conceptual terms. A detailed plan for evaluating the effectiveness of emissions trading in the Lower Fraser Valley can only be prepared once a specific program has been developed.

This discussion highlights two "truths" of program evaluation. To get the most comprehensive evaluation of a program at the lowest cost, it is necessary to:

- Specify the objectives of the program clearly and completely
- Prepare a detailed evaluation plan at the outset

These principles apply equally to the evaluation of emissions trading programs.

Emissions trading programs generally have explicit or implicit goals related to:

- Achievement of air quality goals
- Accommodation of economic growth
- Compliance cost savings

An emissions trading program can also influence:

- The stringency of the air quality goal
- The speed with which the air quality goal is achieved
- The development of innovative technology
- The number of sources participating in the program
- The degree of compliance

To the extent that these effects occur, they are impacts, although not necessarily goals, of the program. Thus, they are a proper subject of inquiry for impact evaluations.

Allowance trading and emissions reduction credit trading programs usually have different goals in these areas, so measures of program impact vary with the type of emissions trading program. When evaluating an emissions reduction credit trading program, it is easier to evaluate each component of the program against its own goals.

The possible measures of effectiveness considered in a process evaluation include:

- Volume of trading activity
- Time lags for executing trades
- Percent of proposed trades approved
- Costs of trading
- Costs of enforcement
- Market behaviour
- Frequency of revision of the rules

These measures of process effectiveness generally apply to both allowance trading and emissions reduction credit trading programs, but the most appropriate measures for a specific program can only be determined after it has been designed.

APPENDIX A:
SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT

The South Coast Air Quality Management District (SCAQMD) emissions trading program is the most active program in the United States. The SCAQMD New Source Review and Banking Rules (Regulation XIII) allowing for emissions trading were initially adopted in 1976. These regulations were amended several times, with the most dramatic amendment on June 28, 1990. This amendment became effective on October 1, 1990. The pre-October 1990 emissions trading market included over 100 trades in the past several years of its existence. Although emissions trading under the pre-October 1990 regulation is no longer in effect, it provides a valuable foundation for other emissions trading programs, especially those in urban areas.

This appendix describes the details of the pre-October 1990 Regulation XIII trading market. The description begins with general information about the New Source Review Regulation, including the geographic areas affected, the adoption date, and the purpose.

GENERAL PROVISIONS

Geographic Areas—Rule 103

The South Coast Air Quality Management District includes Los Angeles, Orange, Riverside, and San Bernardino counties. These areas are further divided into the following areas: Los Angeles Area, Upper Santa Clara River Valley Area, Antelope Valley Area, Mountain Area of Los Angeles County, Island Area of Los Angeles County, Southern Area, Palo Verde Area, Coachella Valley Area, Western Riverside County Area, Joshua Tree Area, San Bernardino Area, Desert Area of San Bernardino County, and Remote Desert Area. All of these areas are governed by the South Coast Air Quality Management District's Rules and Regulations. Some areas are affected by more specific regulations than others.

Adoption

The original New Source Review Rule—SCAQMD Regulation XIII—was adopted in 1976. It has been amended several times since then, with the most drastic amendment on June 28, 1990. The June 28, 1990 amendment took effect on October 1, 1990. This section discusses in detail the New Source Review and Banking Rule prior to the October 1, 1990 amendment. All references to the regulations are the pre-October 1990 version of Regulation XIII.

Purpose—Rule 1301

The purpose of Regulation XIII as defined in pre-October Rule 1301 is as follows:

> *This regulation sets forth preconstruction review requirements for new or modified stationary sources, to ensure that the operation of such stationary sources does not interfere with progress in attainment of the national ambient air quality standards, without unnecessarily restricting future economic growth within the District. This regulation also establishes the requirements and procedures for emission reduction banking.*

Regulation XIII applies to the preconstruction review of stationary sources that emit nonattainment air pollutants. In the SCAQMD, sulfur dioxide (SO_x), nitrogen oxide (NO_x), reactive organic gases (ROG), carbon monoxide (CO), particulate matter (PM), and lead compounds are all considered to be nonattainment air pollutants.

Threshold Levels—Rule 1303

Any new, modifying, or relocating stationary source[1] with a net emission increase exceeding the threshold levels in Table A-1 or with a net emission increase from a

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[1] A stationary source is defined in pre-October 1990 Rule 1302 as "any grouping of permit units or other air contaminant-emitting activities which are located on one or more contiguous properties within the District, in actual physical contact or separated solely by a public roadway or other public right-of-way, and are owned or operated by the same person (or by persons under common control). Such above-described groupings, if remotely located and connected only by land carrying a pipeline, shall not be considered one stationary source."

Table A-1
EMISSION THRESHOLD LEVELS FOR MODIFYING, RELOCATING, OR NEW STATIONARY SOURCES

Pollutant	Threshold Level (lb/day)
Carbon Monoxide	550
Sulfur Dioxide	150
Nitrogen Oxide	100
Particulate Matter	150
Reactive Organic Gases	75
Lead Compounds	3

permit unit[2] at a stationary source that emits a nonattainment pollutant are affected by this regulation. The affected source, unless it is exempt, must obtain offsets to achieve an emission level equal to zero. Once the threshold level is reached for any one contaminant at a source, the source must continue to offset to below the threshold level each time the emissions from that pollutant have a net increase.

Exempt Sources—Rule 1304(a)-(c)

According to pre-October Rule 1304(a), some sources are exempt from complying with the offset and modeling requirements for stationary sources as long as "best available control technology" (BACT[3]) is employed and other requirements are met. These sources and their requirements are as follows:

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[2] A permit unit is defined in pre-October 1990 Rule 1302 as "any article, machine, equipment, or other contrivance, or combination thereof, which may cause the issuance or control the issuance of air contaminants, and which: (1) requires a written permit pursuant to Rules 201 and/or 203 or (2) is in operation pursuant to the provisions of Rule 219." Rules 201, 203 and 219 discuss permits to construct, permits to operate, and equipment not requiring a permit.

- **Fuel Conversion.** This exemption applies to units that are permitted to use liquid fuels in place of gaseous fuels if the natural gas service is curtailed to that area as the result of a federal curtailment mandate. These units must offset their emissions with emissions from other sources owned by a similar entity or must show that no such offsets are available.

- **Portable Abrasive Blasting Equipment.** This equipment is exempt as long as it complies with all state laws.

- **Replacement Units.** A permit unit replacing a functionally identical unit is exempt if the maximum rating and the emissions when operated under the same conditions are not increased.

- **Relocations.** An existing stationary source and all permitted units are exempt if they are relocated to within five miles and the net emission increase does not exceed threshold levels.

- **Portable Equipment.** This equipment is exempt if it is not used for more than 90 days at any one location within a 12-month period. The equipment is required to offset the emissions at the initial location.

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[3] Best Available Control Technology (BACT) is defined in pre-June 1990 as the "most stringent emission change limitation or control technique which: (1) Has been achieved in practice for such permit unit category or class of service; or (2) Is contained in any state implementation plan (SIP) approved by the Environmental Protection Agency (EPA) for such permit unit category or class of source. A specific limitation or control technique shall not apply if the owner or operator of the proposed source demonstrates to the satisfaction of the Executive Officer that such limitation or control technique is not presently achievable; or (3) Is any other emission control technique found by the Executive Officer to be technologically feasible and cost-effective for such class or category of sources or for a specific source. No emissions limitation or control technique, the application of which would result in emissions from a new or modified source in excess of the amount allowable under applicable new source performance standards specified in Regulation IX of these rules and regulations or promulgated by the EPA pursuant to Section 111 of the Clean Air Act, may be considered BACT."

According to pre-October 1990 Rule 1304(b), several sources are exempt from the offset requirements as long as other provisions are fulfilled and BACT is employed. These sources are as follows:

- **Essential Public Services.** These services include schools, hospitals, and police and fire-fighting facilities. These units are exempt if they can provide the required offsets from all other sources owned by the same entity or they can prove that no other sources owned by the same entity can provide offsets.

- **Landfill Gas Control.** Facilities controlling or processing landfill gas are exempt if they can provide the required offsets from all other sources owned by the same entity or they can prove that no other sources owned by the same entity can provide offsets.

- **Resource Recovery and Energy Conservation Projects.** These units are exempt from offsetting only to the extent required by state laws.

- **Research Operations.** These operations are exempt if the purpose of the operation is to conduct investigation, experiment, or research to advance the state of knowledge or the state of the art and a specific time limit not exceeding two years is set for the operation.

According to pre-October 1990 Rule 1304(c), the following units located at minor stationary sources are exempt from obtaining offsets and exempt from proving that stationary sources emitting 25 tons or more per year are in compliance with all federal, state, and district rules:

- **Emergency Electrical Generation Equipment.** This equipment is exempt as long as it is used only for emergency standby for nonutility electrical power generation.

- **Innovative Technology.** This innovative equipment or process must demonstrate that it will result in a significantly lower emission rate than if BACT were employed. In addition, the equipment or process is expected to serve as a model for emission reduction technology, and it cannot affect the ambient air quality standards. This exemption applies only to pollutants reduced by the equipment.

- **Air Pollution Control Equipment.** The control equipment is exempt if it is constructed solely to reduce emissions.

New Source Review Requirements—Rule 1303(b)

Any modified, new, or relocated permit unit or stationary source is required to meet certain requirements in order to be issued a permit to construct. This section discusses the provisions that must be met by such sources as outlined in pre-October 1990 Rule 1303(b). The new or modified permit unit or source must employ BACT for each nonattainment pollutant. Stationary sources affected by this regulation that are considered to be small businesses may take economic impacts into consideration in determining BACT. In addition, a stationary source exceeding the net emission increase threshold levels discussed in the Threshold Levels section must certify that all sources greater than or equal to 25 tons per year of a nonattainment pollutant that are owned or operated by the same person or entity are in compliance with federal, state, and local air regulations. Sources subject to this regulation must show that the total accumulated emissions are offset. Except for ROG emissions that are offset by a source less than eight kilometers (five miles) from the affected unit, modeling is required to show that the ambient air quality standard is not affected.

BANKING

ERC Creation Methods—Rule 1308(a)(1) and Rule 1309(b)(4)

Stationary sources may create emission reductions by adding additional controls at existing units if new applications for permits to construct and operate are submitted or by shutting down existing units and surrendering the permits. For unpermitted units, excluding equipment used in conjunction with a dwelling, the units may be modified by adding controls or shutting down the unit. These modified units are no longer exempt and must meet all the permitting rules. For sources taken out of service, the applicant must demonstrate that the equipment will not be operated again unless the new source review procedures are followed.

Emissions reductions may be created by mobile sources as long as the applicant demonstrates that the emission reduction is real, permanent, and will not be required in the Air Quality Management Plan (AQMP). The emission reduction created by mobile sources may be created by the substitution and usage of high-occupancy vehicles for low-occupancy vehicles or by the installation of controls not required by federal or California rules and regulations.

Calculation of Emissions Rule 1308(a)(2), Rule 1306(c)(1)(A), Rule 1306(c)(1)(B), Rule 1306(c)(2), and Rule 1306(c)(1)(C)

In order to determine whether a source is affected by Regulation XIII, the actual emissions must be calculated. Under the pre-October 1990 rules, the calculation method differs for units without permit limitations and for units with permit limitations installed before October 8, 1976, and after October 8, 1976.

According to pre-October 1990 Rule 1306 (c)(1)(A), emissions from new, modified, or relocated units without any permit limitations are calculated based on:

- The maximum rated capacity;
- The maximum proposed daily hours of operation; and
- The actual materials processed.

According to pre-October 1990 Rule 1306 (c)(1)(B), emissions from modified or relocated units installed prior to October 8, 1976, with permit limitations are calculated as follows:

- The emissions on an annual basis before the reduction or increase are "the sum of actual emissions, as determined from company records, including annual emissions declarations pursuant to Rule 301, or other data approved by the Executive Officer, which have occurred each year during the two year period immediately preceding the date of permit application, or other appropriate period determined by the Executive Officer to be representative of the source's cyclical operation, and consistent with Federal requirements" [that is, the baseline period];

- The daily emissions are calculated by dividing the sum of the actual annual emissions by the total number of actual operating days in each of those two years or other approved period;

- The daily emissions for the two years are multiplied by a usage factor for each year based on the actual number of operating days in that year. The usage factors are:
    - 1.0 when operated 180 days or more,
    - 0.5 when operated 30–179 days, and
    - 0.0 when operated less than 30 days;
- The average daily emission for the two-year period or other appropriate period are calculated; and
- The average daily emissions are multiplied by a reduction factor of 0.9 for shutdown units (except in certain cases).

If adequate records are not available, as determined by the Executive Officer, for units installed prior to October 8, 1976, the actual emissions are calculated using the following factors:

- Fifty percent of the maximum rated capacity;
- The maximum daily hours of operation;
- The actual materials processed as long as the applicant can prove that the subject permit units operated at least 30 days within each of the two years immediately preceding date of permit application;
- A usage factor of 0.5; and
- The reduction factor of 0.9 if the permit unit is removed from service (except for specific cases).

According to pre-October 1990 Rule 1306 (c)(1)(C), emissions for units installed after October 8, 1976, are calculated as they appear in district records.

Discount for Shut-Down Units—Rule 1306(c)(1)(D)

In calculating the emissions associated with equipment that is shut-down and *not concurrently replaced by functionally equivalent permit units, unless units are removed* *as part of a project for which permits to construct are approved*, the emissions are multiplied by a reduction factor of 0.9.

Calculation of Mobile/Other Sources' Emissions—Rule 1306(c)(4)

For mobile and other sources, emissions are calculated based on records or other information by the Executive Officer in a method similar to the emission calculations for stationary sources, with an exception: For light-duty motor vehicles, the emissions are based on the make of the car, the model year, and 30 miles per day driven for each vehicle.

Special Emission Reduction Calculations—Rule 1306(c)(5)

Projects with long lead times that make enforceable reductions between the issuance of the Permit to Construct and the Permit to Operate may claim credit for the reduction using the baseline period immediately preceding the actual date of the reduction.

Eligibility Criteria for Certifying ERC—Rule 1308 and Rule 1309

In order for an emission reduction to qualify as an emission reduction credit (ERC) for use in offsetting or banking, the emission reduction must be enforceable, real, and contemporaneous. The applicant must show that the emission reduction is real by providing data, records, and other information to be able to determine the quantity, the eligibility, and the quality of the emission reductions. The emission reduction must have occurred after January 1, 1980. Finally, an application for the ERCs must be submitted.

Minimum Deposit—Rule 1309(c)

For emission reductions created through a process change, the installation of control equipment, or the modification of equipment, there is no minimum deposit for an ERC. For shutdown-created emission reductions, the minimum deposit is the threshold levels discussed in the Threshold Level section and shown in Table A-1. Once shutdown-created emission reductions accumulate to the threshold level, an ERC is issued. Additional ERCs may be issued as they are created without accumulating.

Deadline for an ERC Application—Rule 1309(e)

The ERC application must be *submitted within 90 days from the date the emission reduction becomes eligible for ERC.*

Administrative Approval Process—Rule 1309(f) and Rule 1310

The Executive Officer must determine no later than 30 calendar days after the receipt of the application (or some longer timeframe, as agreed by the applicant and the Executive Officer) whether the application is deemed complete. If the application is not complete, a written response must explain what is missing and how the application can be deemed complete. After the additional information is submitted, the Executive Officer has another 30 days to deem the application complete. After receipt of the additional information listed as the materials needed to deem the application complete, the Executive Officer may not request additional information or delay the processing of the application. However, the Executive Officer may ask the applicant to clarify, amplify, correct, or supplement the application.

No later than 180 days after the ERC application is deemed complete, a preliminary written decision must declare that all, part, or none of the emissions reductions can be registered as ERCs. Within ten calendar days of making a preliminary decision, the Executive Officer must publish a notice in at least one newspaper of general circulation in the SCAQMD stating the preliminary decision. The public notice must state where the public may inspect the information submitted by the applicant, the supporting analysis for the preliminary decision, and the preliminary decision. The public notice must allow 30 days from the public notice publication date for the public to submit written comments.

No later than the date of the public notice, the Executive Officer must send the preliminary decision and the public notice to the Chief of the Stationary Source Control Division at the Air Resources Board and to the Regional Office of the U.S. Environmental Protection Agency.

Within 180 days after the application is deemed complete, the Executive Officer must make a final decision on the application after considering all written comments. The Executive Officer must provide a final written notice to the applicant, the California Air Resources Board, and the U.S. Environmental Protection Agency, and publish it in a newspaper of general circulation, listing the supporting documents available for inspection.

Public Participation in the Approval Process—Rule 1310(b)

Before a certificate may be issued, a public notice must be published. The comment period on the public notice runs for 30 days. During this time, the public comments are normally fairly light and inconsequential. To the best of our knowledge, the public has not prevented a trade from occurring or a certificate from being issued.

Registration of ERCs—Rule 1309(g)

When the Executive Officer grants the final decision on the ERC, the title is registered in the computerized Register of Titles. All data concerning the title, including liens and encumbrances, are kept in the Register until the Certificate of Title has been legally canceled or nullified.

Certificates of Title—Rule 1309(h)

Each Certificate of Title is numbered consecutively with the date of issuance, the signature of the District official in charge of the Register, the seal of the district, particulars about the owners, including owner's name, owner's marital status and name of spouse, name of minor owner(s), name of deceased if owner is executor or administrator, name of bankrupt or insolvent if owner is trustee in bankruptcy or assignee in insolvency proceedings, and any other information required to meet state laws or regulations.

One copy of the Certificate of Title is retained by the district and one copy is hand delivered to the owner or person acting as the owner. The owner must sign a receipt upon delivery of the certificate. In the case of joint owners, one certificate may be issued or separate certificates may be issues for the proportional share of the ERC. An owner may also consolidate certificates to receive one certificate for the whole amount. The Register of Title reflects this consolidation, and the separate ERCs are canceled when the new certificate is issued.

EMISSIONS TRADING

Offset Factors and Equations—Rule 1307

According to pre-October 1990 Rule 1307, stationary sources required to offset must multiply the quantity of on-site emissions by an offset factor. The offset factor applied to the on-site emissions of the source obtaining offsets is:

$$\text{Offset Factor} = 1.1 + b\,(x)$$

where

x = the distance in kilometers between the new, modified, or relocated source and the offsetting source;

$b = 0$ when x is less than 8 kilometers (5 miles);

$b = 0.01$ when x is equal to or greater than 8 kilometers (5 miles).

The offset factor will not exceed 1.5. Emission reductions created by mobile sources that are not used onsite by the affected unit are multiplied by an offset factor of 1.5.

Geographical Offset Limitations—Rule 1307(b)(2)

Offsets between air basins in California are allowed only if the affected unit proves, through modeling or some other method approved by the Executive Officer, that the offsets are the best available to reduce the pollutants in the South Coast Air Quality Management District *and* the Executive Officer determines that the area of the affected source will result in a net air quality benefit.

Interpollutant Trading—Rule 1308(d)

Particulate emissions may be offset by organic gases, sulfur dioxide, or nitrogen oxide if the applicant shows that no particulate offsets are available and the offset ratio is determined by modeling. The Executive Officer of the California Air Resources Board must be notified when a Permit to Construct is issued with interpollutant offsets.

Utility Deplacement Credits—Rule 1308(g)

Cogeneration and qualifying facilities may receive utility deplacement credits (UDCs) to satisfy their offset requirements. The method for calculating UDCs involves an arduous process and is not based on a 1:1 ratio of the emission increases at the facility to the UDCs granted. The UDCs are based on a calculation of the amount of emissions reduced at another facility caused by the operation of the cogeneration or the qualifying facility. If a facility is qualified to receive more UDCs than are needed, the excess UDCs may *not* be banked or transferred to another facility. In addition, the UDCs may not be banked or transferred if the facility shuts down or curtails operation. It is very difficult to prove that UDCs are permanent.

Transferring the ERC Certificates—Rule 1309(i)

Transfer of all or a portion of an ERC Certificate must be in writing in a form authorized by law, signed by the owner, and filed with the district. Upon filing such instrument, the transfer is complete, and a new certificate will be issued to the new owner, while the old certificate will be canceled.

CURRENT REGULATION XIII

On June 28, 1990, the SCAQMD amended Regulation XIII—New Source Review Requirements, changing the permitting and offsetting requirements. These regulations were spurred in part by a study conducted by the California Air Resources Board (ARB), which showed that about 80% of the emissions in the South Coast come from sources below the pre-October 1990 emission threshold levels. The new emissions trading market has not had enough time to develop under this amended regulation; therefore, the market under the pre-October 1990 regulation was discussed in more detail. The basic changes to the new rules are the following:

- **Lower Threshold Levels.** The new threshold is zero. Thus, any nonexempt new or modified source must offset all emissions increases.

- **No Contemporaneous Requirements for Shutdown-Created Credits.** The pre-October 1990 Regulation XIII required that sources using shutdown created credits must submit their permit application before the shutdown date. The amended regulation alleviated this requirement. Now, any source may use shutdown-created ERCs without regard to the date of the shutdown or the new source permit application.[4]

- **Special Banks for Small Businesses and Essential Public Services.** The amended regulation created a community bank for sources with small emission offset requirements (see Table A-2 for the maximum threshold level) or an NSR Balance of less than 2 tons per year. Each month a certain number of credits are allocated to the Community Bank:

Pollutant	**Monthly Allocation (lb/day)**
ROG	1,500
NO_x	400
PM_{10}	200
SO_2	100
CO	400

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[4] Note that the US EPA has not yet approved the amended Regulation XIII and may disapprove this provision. The SCAQMD has asserted that though this provision is more lenient than federal requirements for new sources with emissions over 100 tpy and modified sources with emissions increase over 40 tpy, when taken as whole, the NSR program is at least equivalent, if not more stringent, than federal laws.

Table A-2
MAXIMUM ALLOCATIONS OF THE COMMUNITY BANK

Air Contaminant	Daily Maximum (lb/day)
ROG	30
NO_x	40
PM_{10}	30
SO_2	60
CO	220

A balance of the number of Community Bank Credits distributed to a source is maintained, and the number of Community Bank Credits obtained by one source cannot exceed the levels listed in Table A-1. Community Bank Credits cannot be banked or transferred. In addition, a source may not gain access to the Community Bank if the facility holds ERCs.

Essential public services are also given the ability to access a priority reserve bank. The purpose of these special banks is to help ensure that small businesses and essential services are not severely affected by the offset requirements.

- **BACT Adjustment.** All actual emissions must be adjusted for BACT when calculating the ERCs.
- **Negative New Source Review Balance Credits.** Since October 8, 1976, the SCAQMD has recorded all emissions increases and decreases at facilities. Under the amended regulation, facilities with net negative emissions in their NSR balance may obtain ERCs for 20% of the NSR balance.
- **Offset Requirements for Positive NSR Balance.** Sources with net positive NSR Balances must offset 20% of the balance when the facility makes a modification. This offset requirement contributes to the district's efforts not only to maintain air quality but also to make progress toward achieving state ambient air quality standards.

- **38 Trading Regions.** The amended regulation created 38 different markets for ERCs by dividing the South Coast. A source required to obtain offsets is restricted as to the location of the offsetting source. The location restriction is based on monitoring areas and the direction of the wind. The map in Figure A-1 shows the 38 trading regions, and Table A-3 shows the areas from which certain trading regions may obtain offsets.

- **Offset Ratio.** Sources using ERCs from the third-party bank must multiply their emission offset needs by 1.2. Community Bank and Priority Reserve credits are traded on a 1:1 ratio.

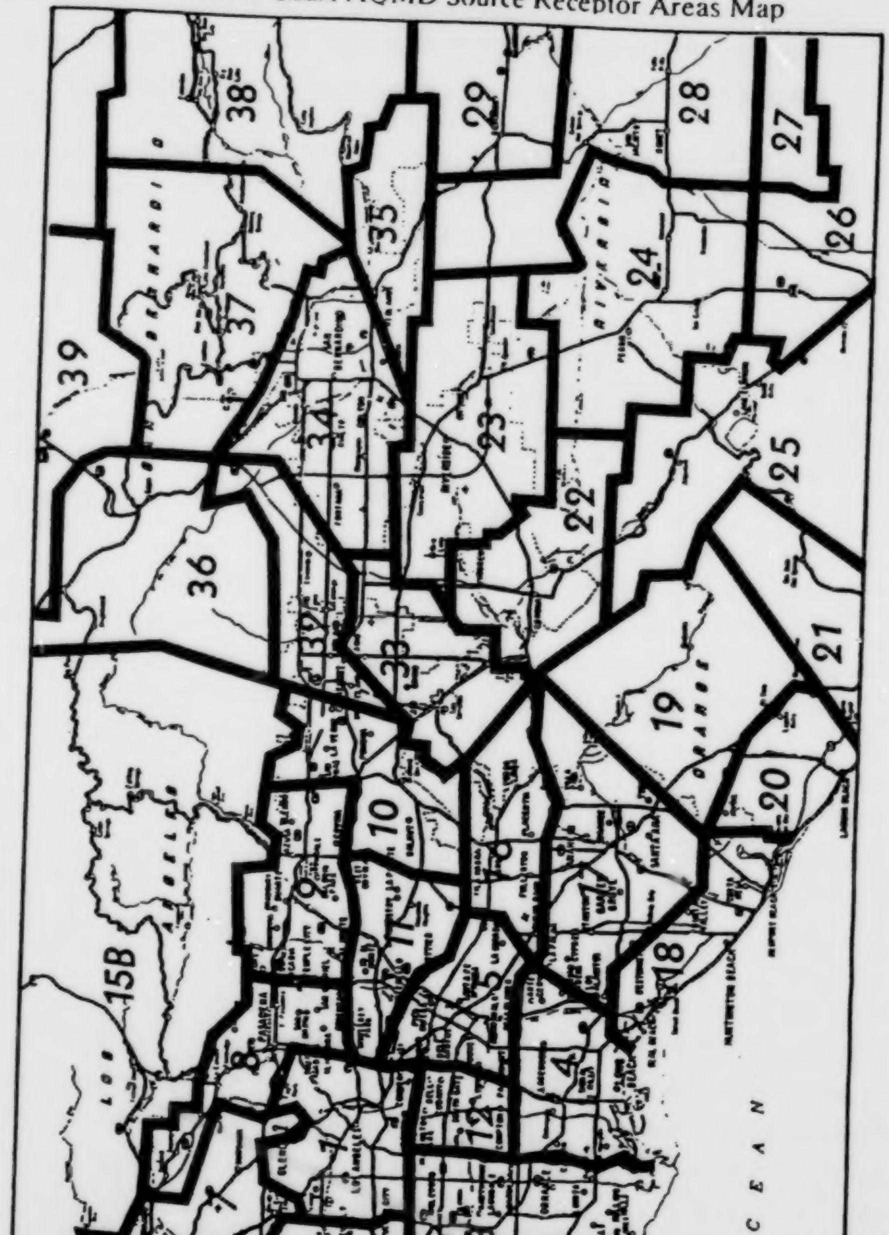
- **Administrative Procedure.** Facilities are issued copies of the certificate of titles for the ERCs as compared to the original. In addition, the tracking system for trades and registration of ERCs is more automated. After the SCAQMD evaluates the ERC and determines a quantity, a public notice is released for ERCs greater than the quantities listed in Table A-2. The applicant is charged a fee of $800 for the public notice. After the 30 day public notice comment period, the SCAQMD takes all the comments into consideration and issues a certificate.

The SCAQMD is still in the process of implementing the amended regulation. Relatively few trades have occurred thus far. In the meantime, the SCAQMD is also proposing a marketable permits program to replace the current system. This program is discussed in the next section.

PROPOSED MARKETABLE PERMITS PROGRAM

The South Coast Air Quality Management District is currently developing a new air control program based on the use of marketable permits. This program is being developed in response to California's recent Clean Air Act which requires that total emissions, including mobile and area sources, be reduced by 5% per year for ROC and 4% per year for NO_x. The system of command-and-control regulation with emissions reduction trading developed to comply with the federal Clean Air Act has not achieved the ambient air quality standards. Although the trading component has been successful in meeting its objectives, increased emissions from exempt, area, and mobile sources have offset reductions in

South Coast AQMD Source Receptor Areas Map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2B
6
13
2A
VENTURA
LOS ANGELES
SAN BERNARDINO
RIVERSIDE
ORANGE
PACIFIC OCEAN
SOUTH COAST
AIR QUALITY MANAGEMENT DISTRICT
SOURCE RECEPTOR AREAS

Figure A-1
Trading Regions Under the Current
SCAQMD Regulation XIII

TABLE A-3

AVAILABLE AREAS FOR OBTAINING EMISSION OFFSETS

(All numbers refer to air quality monitoring areas.)

New Source	Available Offsetting Source Locations
1	1 2 3 4 5 6 7 8 11 12
2	1 2 3 6 7 12
3	1 2 3 4 12
4	1 2 3 4 5 8 11 12 16 17 18
5	3 4 5 12 16 17 18
6	1 2 3 4 5 6 7 12
7	1 2 3 4 5 7 12
8	1 2 3 4 5 8 11 12 16 17 18
9	1 2 3 4 5 8 9 10 11 12 17 18
10	1 2 3 4 5 8 9 10 11 12 16 17 18 32 33
11	1 2 3 4 5 8 9 10 11 12 16 17 18
12	1 3 4 5 11 12
13	1 2 3 4 5 6 7 12 13
14	1 2 6 7 13 14
15	1 2 3 4 5 7 8 9 10 11 12 15
16	3 4 5 10 11 12 16 17 18
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27	3 4 5 10 11 12 16 17 18 19 22 24 27
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29	1 3 4 5 8 9 10 11 12 16 17 18 22 23 28 29 32 33 34
30	1 3 4 5 8 9 10 11 12 16 17 18 22 23 29 30 32 33 34 35
31	1 3 4 5 8 9 10 11 12 16 17 18 22 23 29 30 31 32 33 34 35
32	1 2 3 4 5 8 9 10 11 12 16 17 18 32 33
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36	1 2 3 4 5 8 9 10 11 12 16 17 18 32 33 36
37	1 2 3 4 5 8 9 10 11 12 16 17 18 32 33 36 37
38	1 2 3 4 5 8 9 10 11 12 16 17 18 32 33 36 37 38

regulated point source emissions. Changes to the existing emissions trading system that will limit increases from regulate sources have already been implemented. And approaches to regulating mobile and area sources are being studied.

A marketable permit program for NO_x and ROG would be another way of meeting the emission reduction targets imposed by California's Clean Air Act. It has the advantage of allowing the total number of permits to be matched to total allowable emissions. And it may be easier to control emissions by mobile and area sources through marketable permits than by command-and-control regulation.

The concept is being developed under the auspices of the Deputy Director of the SCAQMD and is supported by the input and review of a "blue ribbon" committee composed of over 30 industrial, environmental, regulatory, and planning experts. This program is proposed to require sources to meet a specific emissions target using a market-based approach.

Both NO_x and VOCs will be controlled under the proposed marketable permit program (MPP). An estimated 14,400 covered facilities emit ROG, and approximately 2,100 covered facilities emit NO_x. The baseline for the MPP will likely be 1990 allowable emissions, because this base year comports with California Clean Air Act requirements.

The program will not allow any increase in actual emissions from a 1990 emission level and will be based on 1990 allowable NSR records. Existing rules with prior effective dates that require installation of control would continue to be in effect; therefore, no backsliding will be allowed by removal of control equipment.

Permits will be issued to all covered units and decreased annually from a base year amount by a factor adequate to produce an overall SCAQMD emission reduction, including mobile and area sources of 5% for ROG and 4% for NO_x. The decrease will continue until the goals of the Air Quality Management Plan are achieved.

There will be a set-aside bank for certain predetermined projects such as essential public services and small businesses. Also, there may be a zero-revenue auction to promote trading and to ease trading for new projects. In a zero revenue auction, the regulatory agency withholds some of the permits for sale by auction. The revenue from the auction is credited to sources on the basis of the number of permits withheld. There is zero revenue to the regulatory agency. Each source receives a combination of permits and cash equivalent to its allocation of permits. The benefit of this approach is that it ensures that there will be a market for permits.

While all covered facilities will enter the program when promulgated, a holder of an emissions permit may be allowed to remain at a previous year's emission rate for an additional year in any three-year period on application to SCAQMD authorities. Such a facility will be required to pay a fee based on the difference between emissions and permit limits and a penalty based on the current BACT guidelines for cost-effectiveness.

All facilities will be required to track emissions pursuant to an approved facility plan that would replace existing permits. All facilities will file a quarterly emission report based on the facility plan and all trading activity. A facility plan will be in place and will be operational until equipment is altered or installed or until new materials are added. Furthermore, emission trades between sources must be recorded and verified through inspections. The reducing facility's limits will be revised to reflect the traded emissions.

Several issues concerning the MPP must be analyzed and resolved before rules can be developed and the program can be implemented. If adopted, the MPP would allow facilities to comply on a facility-wide basis with emission targets. A facility could achieve compliance by purchasing, trading or selling emissions, installing control equipment, or restricting output or production. Basically, facilities could achieve their targets in the least costly manner possible and would not be required to meet source-specific rules.

APPENDIX B:
SAN JOAQUIN COUNTY
AIR POLLUTION CONTROL DISTRICT
NEW SOURCE REVIEW AND BANKING RULES

The following discussion is comprised of five sections. Section 1 addresses general provisions of the San Joaquin County Air Pollution Control District's New Source Review (NSR) and Banking rules. These regulations provide for emissions trading in San Joaquin County. Section 2 focuses specifically upon New Source Review requirements. Calculation procedures and banking provisions are discussed in Sections 3 and 4, respectively. Section 5 concludes the entire discussion with an analysis of several provisions contained in the proposed rules for the San Joaquin Valley Unified Air Pollution Control District, into which San Joaquin County was incorporated in March 1991. It is expected that the proposed rules will be adopted in mid-September 1991. Specific provisions of the proposed rules are contrasted with similar rules contained in current San Joaquin County regulations.

1. GENERAL PROVISIONS

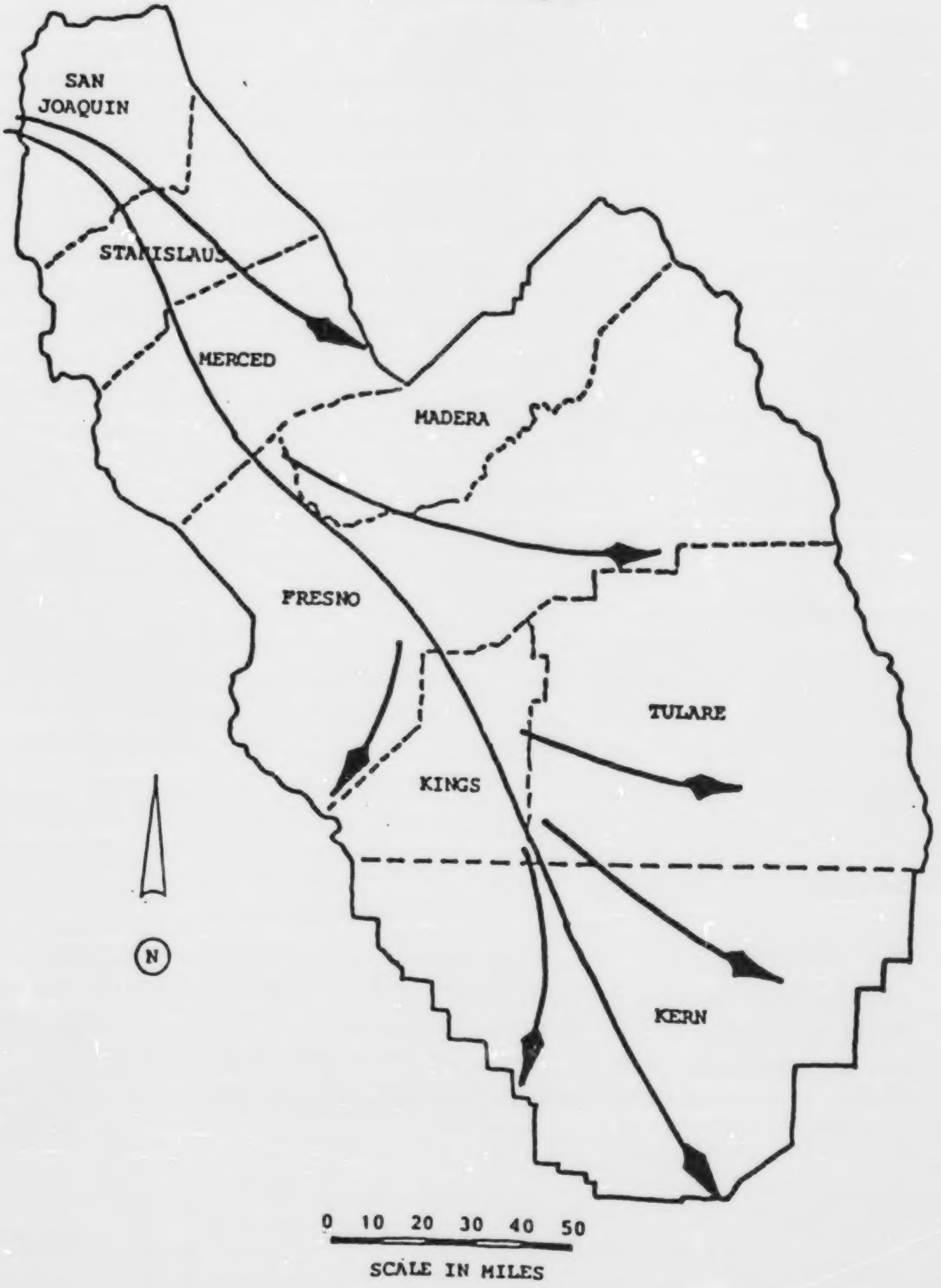
Geographic Areas

The San Joaquin County Air Pollution Control District (SJCAPCD) includes all areas within the geographical boundaries of San Joaquin County. San Joaquin County is the northernmost county located in the San Joaquin Valley air basin. A map of the air basin is provided on the following page.

Adoption

The original New Source Review rule for San Joaquin County—Rule 209.1, New and Modified Stationary Source Review—was adopted on May 29, 1979. The rule has been amended significantly since its adoption. The most recent version of the rule was adopted on August 22, 1989. The first Banking rule—Rule 209.5, Emission Reduction Credit Banking—went into effect in 1987.

PREDOMINANT SUMMER WIND FLOW
for the
SAN JOAQUIN VALLEY
AIR BASIN
(June, July, August)


SAN JOAQUIN
STANISLAUS
MERCED
MADERA
FRESNO
TULARE
KINGS
KERN
N
0 10 20 30 40 50
SCALE IN MILES

Purpose—Rule 209.1, Part 1(A), Rule 209.5, Part 1(A)

The purpose of the SJCAPCD New Source Review regulation is defined in the rule as follows:

1. [To] *provide for the review of new and modified stationary sources of air pollution and provide mechanisms, including emission trade offs, by which Authorities to Construct such sources may be granted without interfering with the attainment and maintenance of air quality standards, and*

2. [To] *provide relief from offset requirements where a growth allowance provides for emission reductions equal to or greater than those emission reductions which would be obtained from offsets pursuant to the full application of this rule.*

The purpose of the Banking regulation is defined in the rule as follows:

1. [To] *encourage industrial growth while maintaining progress toward enhanced environmental quality:*

2. [To] *encourage the development of innovative pollution control methods and technologies and reduce the cost of pollution control;*

3. [To] *provide an administrative mechanism for sources to store surplus emission reductions: (a) for later use in bubbles, netting, or as offsets where allowed by rules and regulations; or (b) for transfer to other sources for use in bubbles or as offsets where allowed by district rules and regulations, or state and federal rules and regulations; and*

4. [To] *define eligibility standards, quantitative procedures, and administrative practices to ensure that Emission Reduction Credits (ERCs) are real, permanent, quantifiable, and enforceable.*

Applicability—Rule 209.1, Part 1(B), Rule 209.5, Part 1(B)

San Joaquin County's New Source Review rule applies to those new and modified sources that emit or will emit nonattainment pollutants. The entire SJCAPCD is not in attainment with respect to the state and federal ambient air quality standards for ozone (O_3) and particulate matter (PM_{10}). Sources that emit precursors to either of these nonattainment pollutants must offset those emissions as well. O_3 precursors include reactive organic compounds and nitrogen oxides (NO_x). Sulfur oxides (SO_x) are considered to be a precursor to PM_{10}. Only the metropolitan area of Stockton is nonattainment for carbon monoxide (CO).

2. NEW SOURCE REVIEW REQUIREMENTS

Exemptions—Rule 209.1, Part III(B)6

The SJCAPCD NSR regulation mentions only emergency standby generators as sources that may be exempt from offset requirements. The electrical generation equipment must satisfy certain conditions in order to be determined exempt.

Offset Threshold Levels—Rule 209.1, Part III(B)1

Effective August 22, 1989, through June 30, 1991, new or modified stationary sources must offset net emission changes of any nonattainment pollutant or precursor exceeding the following levels:

NO_x, reactive organic compounds, or SO_x	150 lbs/day
PM_{10}	80 lbs/day
CO	550 lbs/day

(Prior to August 22, 1989, offset thresholds were 250 lbs/day for NO_x, reactive organic compounds, SO_x, and PM, and 550 lbs/day for CO.)

After a source has exceeded these levels and has offset its emissions down to zero, the source must offset any further net emission increases. The net emission change for a stationary source is equal to the sum of emission changes for all emission units within the stationary source since May 29, 1979.[1]

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[1] All negative emission changes that have occurred since August 22, 1989, must be multiplied by a factor of 0.9 when determining the net emissions change. The balance of the negative emission change is credited to the small source siting allowance. This factor is not applied to banking certificates, interpollutant offsets, or emission offsets.

Beginning July 1, 1991, offset threshold levels in San Joaquin County were dropped to zero for NO_x and reactive organic compounds, as well as for CO in nonattainment areas. These threshold levels mirror those proposed in the draft of the NSR rule to be adopted by the San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD). San Joaquin County and seven other counties within the San Joaquin Valley air basin incorporated to form this air district in March, 1991. Regulations proposed for adoption by the SJVUAPCD are discussed in Section 5.

Offset Ratios/Geographical Limitations--Rule 209.1, Part III(B)4

New and modified sources must provide offsets at ratios from 1.3:1 to 3.1:1, depending on the distance between the source requiring offsets and the source providing offsets. However, emission reductions created at a source more than 50 miles downwind are unacceptable for offsetting purposes. Offsets from districts other than that in which the proposed new source or modification is located may be used only upon determination by the Air Pollution Control Officer (APCO) that the offsets meet the requirements of SJCAPCD rules. The following table presents the offset ratios corresponding to distances less than 50 miles downwind from the new or modified source.

Location	Offset Ratio
Within 15 miles of the same source	1.3 to 1
Within 15 to 50 miles of source and within air basin	2.1 to 1
Upwind of source more than 50 miles and within same air basin	3.1 to 1
None available or more than 50 miles downwind	Application is denied

Other Offset Limitations--Rule 209.1, Part III(B)5(b)

Emission reductions created by shutdowns of existing sources or permanent curtailments in production or operating hours that occurred *before* the permit application for the new or modified source was filed cannot be used as offsets. However, such offsets may be approved if the applicant can prove that the reductions were created after August 7, 1977, and that the proposed new source of modification is a replacement for the shutdown or curtailment.

Interpollutant Offsets—Rule 209.1, Part III(B)5(d)

Interpollutant offsets may be approved on a case-by-case basis and the APCO may impose offset ratios greater than the requirements in such cases. SJCAPCD rules explicitly prohibit interpollutant trades of PM_{10} for NO_x or reactive organic compounds in O_3 nonattainment areas, as well as trades of PM_{10} for SO_x in sulfate nonattainment areas.

Additional New Source Review Requirements—Rule 209.1, Part III(C)1,3

In addition to providing offsets for net emission increases, applicants in the SJCAPCD are required to apply Best Available Control Technology (BACT) to new or modified emission units whose net emission change exceeds zero for NO_x, PM_{10}, reactive organic compounds, or SO_x, or exceeds 550 lbs/day for CO. Other New Source Review requirements include alternative siting analysis for identified sources and a demonstration of compliance at all other major stationary sources under the same ownership as the applicant.

Small Source Siting Allowance—Rule 209.1, Part VII

The SJCAPCD NSR regulation provides for the establishment of a small source siting allowance to assist small sources to comply with offset requirements. The allowance was funded through the preservation of 10% of all on-site emission reductions occurring after August 22, 1989. The rules are silent regarding restrictions on access to the small source siting allowance and did not specify how many times a small source could obtain offset assistance. The credits were available to small sources on June 30, 1991. As the small source siting allowance was replaced by the San Joaquin Valley Unified Air Basin community bank on July 1, 1991, it was never used.

3. CALCULATION OF EMISSIONS

Calculation of Emission Reductions—Rule 209.1, Part V(C)2(c)

A facility's actual emissions are the basis upon which actual emission reductions for use as offsets or in banking certificates are calculated. The SJCAPCD New Source Review rule specifies that actual emission reductions are to be calculated in pounds per day by dividing the total emissions (in lbs/day) emitted over the calendar quarter by the number of days in the calendar quarter.

Baseline—Rule 209.5, Part II(D)

The Banking rule for the SJCAPCD notes that the baseline for the purposes of calculating the quantity of emission reductions to be certified shall be the average actual emissions from a period representative of normal source operations. The suggested baseline is the three consecutive years of operation immediately preceding the date the emission reduction occurred. However, the rules provide for use of a more representative time frame as long as that time frame falls within the five-year period preceding the date the application was submitted.

4. BANKING

ERC Creation Methods—Rule 209.5, Part IV(F)

The SJCAPCD banking rule specifies the following methods of creating emission reductions:

- Achievement of greater operating efficiency at a permitted source;
- Application of more efficient control technology at a permitted source;
- Shutdown of a permitted source;
- Reduced production or production rates from a permitted source; and
- Achievement of greater operating efficiencies or more efficient control technology to an *unpermitted* source.

Eligibility Requirements for ERCs—Rule 209.5, Part III(1)

Emission reductions are recognized as ERCs only after they have met the following criteria:

- They must be real, surplus, permanent, quantifiable, and enforceable.
- They must not be required by federal, state, or district permits, agreements, orders, rules, or regulations, must not be required by the approved State Implementation Plan (SIP), and must not have been used to meet reasonable further progress.
- If created by shutdowns or permanent curtailments, they must not be exceed the level of emissions associated with compliance with existing rules and regulations.

Furthermore, the emission reduction must have occurred on or after May 29, 1979, or the most recent emission inventory used in the SIP, whichever event was most recent.

Deadline for ERC Application Submittal—Rule 209.5, Part IV(E)

ERC certificate applications must be submitted within 18 months after the emission reduction occurs.

Administrative Approval Process—Rule 209.5, Part VII

A fee of $650 must accompany all ERC applications. The SJCAPCD Banking rule outlines an administrative review process with specific time frames in which the Air Pollution Control Officer (APCO) must respond to the ERC applicant. There is also a public review process in which the public has 30 days to submit written comments on the merits of the ERC Certificate Application. Following the public comment period, the APCO has 30 days to render a decision on the approval of the application and to publish the decision in a local newspaper.

5. SAN JOAQUIN VALLEY UNIFIED AIR POLLUTION CONTROL DISTRICT NEW SOURCE REVIEW AND BANKING RULES

On March 20, 1991, eight regulatory air pollution control agencies joined forces to form one unified air pollution control district. The San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD) now has control over air-pollution-control-related activities in San Joaquin, Stanislaus, Merced, Madera, Tulare, Kings, Fresno, and parts of Kern County. The SJVUAPCD will adopt a uniform rule book to govern all air-pollution-emitting activities in the San Joaquin Valley air basin. The New Source Review and Banking rules for the SJVUAPCD are scheduled for adoption in mid-September 1991. The following discussion focuses on some of the provisions of the proposed rules that will mean new requirements for sources in San Joaquin County. (At the time of writing, these rules were still in draft format.)

General Provisions

Purpose—Rule 220.1, Part I(A)3

In addition to the purposes of the SJCAPCD NSR rule, described above, the San Joaquin Valley Unified APCD NSR rule has the additional purpose of:

- *Providing for no net increase in emissions from new and modified sources for all nonattainment pollutants and their precursor except for* PM_{10}

New Source Review Requirements

Exemptions—Rule 220.1, Part I(B)1

The SJVUAPCD rules contain a more comprehensive list of sources that are exempt from offset requirements, including temporary replacement emission units and soil or groundwater decontamination projects. Other exemptions are also discussed.

Offset Threshold Levels—Rule 220.1, Part III(B)3

The offset threshold levels for increases of nonattainment pollutants and their precursors remain the same as those specified in the San Joaquin County rules, except for NO_x, volatile organic compounds, and CO in nonattainment areas. Upon adoption of the SJVUAPCD rules, all increases in permitted emissions of these pollutants will have to be offset.

Offset Ratios/Geographical Limitations—Rule 220.1, Part III(B)4

Offset ratios will be slightly modified, ranging from 1.2:1 to 3:1. Internal offsets or offsets obtained from the community bank will be applied at a 1:1 ratio.

Community Bank Allowance—Rule 230.2

In addition to the 10% of on-site emission reductions taken by San Joaquin County, the community bank for the SJVUAPCD will reserve all excess offsets obtained pursuant to offset ratios, i.e., offsets in excess of a 1:1 trading ratio. Furthermore, the Community Bank rule specifically indicates annual emission limitations and other eligibility requirements for community bank applicants. The bank is to be divided into three regional banks. Qualifying offsets will be deposited into the bank serving the area in which they were generated, and allocations will only be distributed within the region of origin.

Calculation Methods

Baseline Period—Rule 210.1, Part II(F)

SJVUAPCD's New Source Review rule defines the baseline period as the two consecutive years of operation immediately prior to the submission of the complete application.

Banking

Deadline for ERC Application Submittal—Rule 230.1, Part IV(B)3

ERC Certificate Applications must be submitted within 180 days after the emission reduction occurs.

APPENDIX C:
BAY AREA AIR QUALITY MANAGEMENT DISTRICT[1]

PROGRAM DESCRIPTION

The Bay Area Air Quality Management District's (BAAQMD) Emissions Banking Program (Regulation 2, Rule 4) was initially adopted March 7, 1984. It was intended to provide a mechanism for sources to obtain offsets under the New Source Review (NSR) regulations (Regulation 2, Rule 4). However, the recent California Clean Air Act requires a permit program to be adopted to achieve a "no net increase" of nonattainment pollutants or their precursors from all new and modified sources (Section 40919(a)(1), California Health and Safety Code). In the BAAQMD, this meant that changes to its permitting program were necessary to ensure that increases in precursor organic compounds (POCs) or NO_x emissions from new or modified sources be accompanied by compensating reductions of the same pollutant, since POC and NO_x are precursors of ozone.

The program applies to new sources and sources undergoing major modifications in BAAQMD's nine- county district, which includes San Francisco, San Mateo, Santa Clara, Alameda, Contra Costa, Napa, Marin, and part of Sonoma and Solano counties.[2] Exemptions exist for a wide variety of sources except where such sources emit more than 150 pounds per day of a given pollutant. Bankable pollutants include precursor organic compounds, nonprecursor organic compounds, particulate matter, PM_{10}, sulfur dioxide, nitrogen oxides, and carbon monoxide (2–4–203).

To date, the emissions bank has received little use. However, significant changes to Regulation 2 were approved on July 17, 1991. The changes involve, among other things, significantly lower emission thresholds. The discussion below applies both to the pre-July 17 program and the new rules. This twofold discussion allows the program to date to be assessed and sheds light on the need for the recent changes.

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[1] Sources include BAAQMD "Regulation 2, Rule 4 Emissions Banking" (3/7/84); BAAQMD Proposed Changes to "Regulation 2, Rule 1 General Requirements" (6/5/91); BAAQMD memo from the Air pollution Control Officer to Chairperson Cooper and the Board of Directors re. "Continuation of Public Hearing to Consider Adoption of Amendments to Regulation 2, Rules 1, 2, and 4, New Source Review Permits" (6/26/91); and Personal Conversation with William deBoisblanc, P.E., Manager of New Source Review (7/91).

[2] Major modifications to major facilities are defined as those that cause an increase in facility emissions by the following amounts or more: POC, NO_x, or SO_2, 40 tons per year; PM10, 15 tons per year; PM, 25 tons per year; CO, 100 tons per year (2-2-221).

CREDITS AND THEIR CREATION

Actual emission reductions are those that exceed the reductions required by the Air Quality Management Plan or the Clean Air Plan and are real, permanent, quantifiable, and enforceable.[3]

Bankable reductions can be created in a number of ways, among them: installation of control technology more stringent than required by law (e.g., installation of BACT where BACT is not required); installation of processes or equipment that emit fewer than emissions than the previous processes or equipment that performed the same function; use of abatement equipment and the acceptance and adherence to permit conditions more stringent than otherwise required by district regulations; permitted fuel-switching; and reduction in fugitive emissions if the results are verified by source tests (2-4-301). 25% of actual emissions reductions that result from installation of best available retrofit control technology are also eligible.[4]

The baseline for calculating emission reduction credits (ERCs) is the highest twelve-consecutive-month period of *actual* emissions to occur in the five years preceding the application.[5] Prior to the July 17 amendments, the baseline used was the last two years of actual emissions immediately prior to the emission reduction.

BANKING PROVISIONS

Deposits into the ERC bank are permanent until used or transferred (2-4-409).

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[3] Prior to the July 17 changes, an emissions reduction had to be in excess of that achievable by RACT.

[4] This provision was added July 17.

[5] BAAQMD, Memo from APCO to Chairperson Cooper et al., "Continuation..." p. 4.

Restrictions

- Emissions reductions resulting from source shutdowns are bankable only if the applicant accepts a condition restricting use of the deposits to offsetting emissions increases within the same or closely related industries (2-4-02.1). However, reductions from shutdowns where the demand would merely shift to other sources in the district with little or no reduction in emissions basin-wide cannot be banked (2-4-303.2). Prior to July 17, it was also required that shutdown-related credits be allocated only to the extent that the reduction exceeds that available through reasonably available control technology (RACT).

- Emissions reductions from sources excluded from District regulations or exempt from permit requirements cannot be banked (2-4-303.3).

Prior to July 17, it was also required that POC and CO ERCs resulting from shutdowns be used at the same stationary source where the shutdown resulted.

Limitations

Emissions reductions may not be used:

- To exempt a source from best available control technology (BACT) (2-4-304.1);

- To exempt a source from emission limitations in the New Source Performance Standards (2-4-304.2); or

- To exempt a source from any other air pollution control requirements whatsoever (2-4-304.3).

Application to deposit emissions reductions from a stationary source for pollutants that are the subject of a variance or abatement order will not be accepted (2-4-402).

Application Requirements

An applicant wishing to deposit an actual emissions reduction has 18 months to complete an application from the date of closure, implementation of additional controls, changes in processing or equipment, fuel-switching, or other such action that resulted in reduction (2–4–402.1). However, the July 17 amendments provided that actual emissions reductions that occurred prior to December 5, 1989, may also be considered if (1) the application is completed before December 31, 1991; (2) the emissions reduction exceeds reductions achieved or achievable by RACT; and (3) the emissions reduction is calculated from the 12-month period immediately preceding reduction. Pre-December 5, 1989 reductions are multiplied by the following credit factors: 1 for emissions reductions after June 5, 1989; .5 for emissions reductions June 6, 1987 through June 5, 1989; and .25 for emissions reductions June 5, 1985 through June 5, 1987) (2–4–402.2.5).

Review Process

A preliminary decision on deposits is generally made within 90 days (30 days for a review of application completeness, plus 60 days from the time the application was deemed complete until the issuance of a preliminary decision) (2–4–403 and 2–4–404).

Any person dissatisfied with the air pollution control officer's (APCO's) decision may appeal to the Hearing Board of the District (2–4–408).

Provision for Public Involvement

Before approving the banking of any emissions reductions in excess of 40 tons per year per pollutant or before declaring a moratorium on banking, the APCO must publish a notice indicating such action for public comment (2–4–405). Public meetings may be held based on the receipt of written comments after the public notice has been published (2–4–406).

Monitoring and Enforcement

Most emissions reductions are enforceable by permit conditions written into the authority to construct and the permit to operate. However, in the case of source closures, an irrevocable and legally binding agreement is used (2–4–201).

Withdrawal Procedures

Deposits are withdrawn in accordance with offset ratios specified in Rule 2 (2–4–412.1). In order to withdraw a deposit, the Banking Certificate must be surrendered. If the deposit is only partially used, the district issues a certificate for the remainder.

Special Banks

A small facility bank was established July 17, 1991. It will grant POC offsets (monthly) to small facilities that emit less that 25 tons per year of POC. The following conditions apply (2–4–414):

- Allocation of offsets from this bank must be no less frequent than one per month;
- The amount granted must be no more than one-twelfth of the small growth allowance included in the Clean Air Plan;
- If more offsets are requested than available, offsets must be allocated to the applicants requesting the least amount of credits;
- The applicant must have best available retrofit control technology (BARCT) installed on all existing POC sources and no other actual emissions reductions credits available;
- Allocations cannot be transferred or banked;
- If a monthly allocation is not used, the remainder of the allocations are used to satisfy the state's "no net increase" provision of the Health and Safety Code; and

- Unallocated offsets are transferred to the Clean Air Plan Reductions.

TRADING PROVISIONS

Requirements and Restrictions

Offsets

Emissions offsets are actual emissions reductions from the emissions bank, or contemporaneous actual emissions reductions occurring after submittal of the application but prior to the issuance of a permit to operate.

The offset threshold is the level of emissions from a source, above which offsets must be provided before a permit may be issued. The thresholds for POC and NO_x are one ton per year (lowered from 40 and 100, respectively).

The following ratios currently apply (tons of offsets required per ton of increase):

Emissions in Tons/Year	Offset Ratios	
	POC	NO_x
< 25	1.05:1	1.05:1
≥ 25, < 100	1.10:1	1.10:1
≥ 100	1.20:1	1.20:1

Offset ratios for TSP, PM10 and SO_2 are 1.1:1 and apply to facilities emitting 100 tons or more of pollutants. CO offsets may or may not be required for emissions of 100 tons or more, depending on the result of air quality modeling.[6]

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[6] This flexibility exists because it is recognized that mobile sources are major contributors in this area.

Prior to the July 17 amendments, the following offset ratios applied:

Distance From Stationary Source	Required Offset Ratio (POCs and NO_x)
On or off-site but not over 2 miles	1.1:1
Off-site over 2 miles but not over 15 miles	1.2:1
Over 15 miles but not over 30 miles	2.0:1
Over 30 miles	>2:0:1

Offsets for CO, particulate matter, PM_{10}, nonprecursor organic compounds, and SO_2 were subject to offset ratios of 1.1:1 when increased emissions and actual emissions reductions were from the same stationary source. When increases and reductions were not from the same stationary source, the APCO would determine an appropriate ratio (not less than 1.1:1) based on modeling.

Procedure for Transfers

If a deposit is transferred to another source, the owner of record submits the Banking Certificate signed by the owner of record and the new owner. The district issues a new certificate to the new owner for the amount transferred, and a new certificate to the existing owner for any amount not transferred (2-4-412).

If the deposit is transferred for use in connection with an authority to construct that requires offsets, the Banking Certificate is signed both by the old owner and the new owner and submitted to the district. The district issues a new certificate to the seller for any untransferred portion and identifies use of the certificate in the buyer's authority to construct (2-4-412.5).

Bubbles

No multiplant bubbles are allowed.

Enforcement

The permit procedures require a review of equipment design and inspection of equipment after installation to ensure emissions compliance. The permits required are the "authority to construct" and the "permit to operate." Authority to construct is denied if required offsets are not provided. Violation of the authority to construct agreement results in the denial of the permit to operate.

Geographic Restrictions

Prior to July 17, offset ratios were linked to distance from the ERC source. This is no longer the case.

In the case of attainment pollutants, offsets from outside the district are not strictly prohibited. However, it is questionable whether in practice such offsets would be allowed.

Inter-pollutant Trading

At the discretion of the Air Pollution Control Officer, NO_x and SO_2 may be used to offset PM_{10}.[7] However, while this provision has been in place for some ten years, it has never been utilized.

Liability

The creator of the deposit retains responsibility for maintaining the permanency of the emissions reduction. The user of any transferred deposit is not held liable for any failure of the creator to comply (2–4–414).

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[7] The reasoning behind this provision is that sulfur and nitrogen-based substances are a significant portion of the residue found in PM_{10} filters.

AVAILABILITY OF INFORMATION

A "banking register" of application, deposit, withdrawal, and transaction data is available to the public upon request (2-4-410). Information on price and transaction dates is not available.

MARKETING

No marketing has occurred.

ADDITIONAL STANDARDS OR REQUIREMENTS

Air Quality Modeling

An authority to construct cannot be issued if the cumulative increase from the PSD database minus contemporaneous reductions exceeds:

- 40 tons per year of SO_2 or NO_2; or
- 25 tons per year of TSP; or
- 15 tons per year of PM10; or
- 100 tons per year of CO.

Unless modeling shows that federal ambient air quality standards and the PSD increment will not be exceeded, as applicable (2-2-304,305).

Control Technology Requirements

BACT now applies to the following *(the previous standards are indicated in parentheses)*:

- Any new or modified source emitting more than 5 pounds per day on the highest day or 365 pounds per year of precursor organic compounds *(150 pounds per day)*, nonprecursor organic compounds *(150 pounds per day)*, nitrogen oxides *(150 pounds per day)*, sulfur dioxide *(150 pounds per day)*, particulate matter *(150 pounds per* *day)*, PM$_{10}$ *(80 pounds per day)*, or carbon monoxide *(550 pounds per day)* (2-2-301.1).

- Any new or modified source that emits on a single day more than the following amounts, or any new or modified source at a stationary source that will result in a cumulative increase at the stationary source since December 1, 1982, in excess of the following annual *(or daily)* amounts: lead (.6 ton/year, 3.2 lb/day); asbestos (.007 ton/year, .04 lb/day); beryllium (.0004 ton/year, .002 lb/day), mercury (.1 ton/year, .5 lb/day); vinyl chloride (1 ton/year, 5.5 lb/day); fluorides (3 ton/year, 16 lb/day); sulfuric acid mist (7 ton/day, 38 lb/day); hydrogen sulfide, total reduced sulfur, or reduced sulfur compounds (10 ton/year; 55 lb/day) (2-3-301.2).

BANKING AND TRADING ACTIVITY

	Cumulative Reductions in Tons/Year 1985 through mid-1991					
	Part	Pre Org	NO$_x$	SO$_2$	CO	NonPre Org
RACT Reductions to Date	194	2610	1354	685	1343	105
Unresolved Proposed Reductions*	4	1959	101	2100	6	16
Withdrawals for Use**	5	1822	124	25	8	0
Current Bank Balances	163	1720	1295	1179	392	218

* Includes incomplete applications and disputed results from years past.

**The percentage of internal versus third-party trades is unknown.

The cost of POC offsets is currently estimated to be in the range of $2000 to $4,000 per ton. NO$_x$ offsets are somewhat higher.[8]

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[8] BAAQMD, Memo form the Air Pollution Control Officer to Chairperson Cooper and Members of the Board of Directors on "Continuation of Public Hearing to Consider Adoption of Amendments to Regulation 2, Rules 1, 2, and 4: New Source Review Permits" (June 26, 1991).

APPENDIX D:
NEW JERSEY'S EMISSIONS TRADING PROGRAM[1]

PROGRAM DESCRIPTION

The purpose of this program is to improve air quality. The program applies to new or significantly altered stationary sources in New Jersey whose emissions of a criteria pollutant have increased 50 tons or more since 1976. Criteria pollutants include ozone, total suspended particulate matter (TSP), sulfur dioxide, nitrogen dioxide, volatile organic substances, carbon monoxide, and lead. Exemptions exist for temporary facilities that will not operate in the nonattainment area for more than six months (Sec. 18.6).

CREDITS AND THEIR CREATION

Definition

Emissions credits are any reductions that are real, permanent, surplus, quantifiable, and enforceable.

Emission reduction credits (ERCs) can be created by:

- Installing air pollution control equipment that reduces the rate of the actual emissions to less than that of the allowable emissions;
- Applying fugitive emission control measures that reduce the rate of the actual emissions to less than that of the allowable emissions;
- Reducing production rates or operating hours to less than the actual rates or hours for the year immediately preceding such reductions or for any representative year within five years of the reductions;

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[1] Unless otherwise noted, the following information was provided by Pat Zigrand, Supervisor, New Jersey Department of Environmental Protection, Bureau of Resource Review (7/24/91) in reference to NJAC 7:27-18.

- Reducing emissions by establishing and supporting business travel control measures or employee commuter travel control measures, provided that the reductions are quantifiable and enforceable and that they are not already required;
- Adopting any other measures approved by the New Jersey Department of Environmental Protection for reducing the rate of actual emissions to less than that of allowable emissions (18.4 (a)).

Baseline

The appropriate baseline for calculating ERCs is established on a case by case basis. Generally speaking, an average is taken over some recent and representative time period.

BANKING PROVISIONS

Restrictions

Credit Lifetime

There is no time limit on the lifetime of a banked ERC. However, they can be discounted once they are banked. Upon transfer to another party, banked reductions are recalculated according to the regulations in place at the time of the transfer (Sec. 7.27-18.7).

Minimum Deposit

There is no minimum deposit required for the banking of ERCs.

Unpermitted Reductions

Certain unpermitted sources are grandfathered into the rules. ERCs from these sources can be banked.

Other

If reductions are required in order for ambient air quality standards to be obtained, or if the measures by which ERCs were created are mandated, then any of the following may occur:

- ERCs may be confiscated;
- Reductions may be obtained from existing operating sources with no effect on banked ERCs; and
- Banked ERCs may be discounted by the percentage reduction required in the nonattainment area.

Application Requirements

Applications for ERCs must be submitted within 12 months of creation. For a shutdown, the department must be notified at least 60 days prior to the removal of the equipment so that department inspection is possible.

The application consists of a single form and is accompanied by a $400 fee per source.

Review Process

Field office verification and site inspection is generally required for ERC verification, although there are some exceptions. The time between application submittal and the approved banking of ERCs can range from 0 to 6 months.

Provision for Public Involvement

There is no provision for public participation in the decision to issue ERCs.

Special Banks

There are no special or "community" banks.

TRADING PROVISIONS

Eligibility

Stationary sources are eligible, but individuals are not recognized as eligible to own ERCs. The agency is not involved in the matching of buyers and sellers.

Offsets

Emission offsets must exceed the minimum offset ratios and be within the minimum distances specified below (Sec. 18.4(b)):

	Distance of Offsets from Facility (Miles)	Minimum Offset Ratio
VOC and NO_2	0–100	2:1
	100–250	4:1
	250–500	8:1
SO_2, TSP and CO	0–0.5	1:1
	0.5–1	1.5:1
	1–2	2:1
Lead	on-site	1:1

Offsets must comply with the following restrictions:

- They must be of like quality and nature to the emissions being offset;
- In the case of SO_2, lead, and suspended particulates, offsets must have an effective stack height no greater than that of emissions being offset;
- In the case of lead, offsets must come from the same facility as the increase.

Other Requirements and Restrictions

- Transferred ERCs must be applied to specific projects.
- Winter VOC reductions may not be used to offset summer increases.
- All existing facilities owned, operated, or controlled by the entity seeking to increase emissions of a criteria pollutant in a nonattainment area must be in compliance with the Federal Clean Air Act or must be on an enforceable compliance schedule approved by the department (Sec. 18.2(c)).
- Shutdown-created emissions reductions can be used by an industry type other than the source type that created the reductions, and these reductions need not be contemporaneous with the increase.
- Banked ERCs cannot be leased.

Procedure for Transfers

A notarized letter on the seller's letterhead, signed by both the seller and the buyer, is required. A $50 fee per transfer per source is also assessed. A new certificate is generally issued within a week.

Bubble Provisions

Multiplant bubbles are only allowed for existing sources. Each bubble is processed as a site-specific SIP revision to be approved by the EPA.

Geographic Restrictions

Different geographic restrictions on trading apply for each criteria pollutant.

Interstate transfers can in theory be allowed if approved by the states involved.

Inter-Pollutant Trading

Inter-pollutant trading is not allowed.

Liability

If the source was in violation at the time of ERC creation, the buyer is in jeopardy and must obtain further ERCs. If the ERC creator is in violation of its emissions requirements at a later time, there is no liability for the buyer.

AVAILABILITY OF INFORMATION

The bank tracks trades by computer. While a list of sources owing ERCs is available, a list of buyers and sellers with transaction information is not available.

MARKETING

The renewal notice that is sent for a facility's permit, there is a paragraph included which states that a trading program is available. More extensive marketing efforts have not been attempted.

ADDITIONAL STANDARDS OR REQUIREMENTS

- Each new or altered equipment of facility must be controlled to the lowest achievable emission rate (LAER);
- Air modeling is generally not required but can be in specific situations. Where it is required, it must be shown that: the ambient impact of the increase is completely offset and that the increase does not contribute significantly to any nonattainment status; and
- An entity attempting to increase emissions of a criteria pollutant in a nonattainment area must analyze and assess the feasibility of business travel control measures and employee commuter travel control measures at the subject facility.

BANKING AND TRADING ACTIVITY

The following are rough approximations of the banking deposits that have occurred in recent years. In most cases, only a handful of companies are involved.

	Tons/Year of Pollutant				
	Part	NO_x	SO_2	CO	VOC
1989	156	62	88	9	243
1990	143	43	7	34	330
1991	4	53	100	13	13

It appears as though less than ten third-party trades have occurred in the history of the program.

APPENDIX E:
JEFFERSON COUNTY, KENTUCKY[1]

PROGRAM DESCRIPTION

The Jefferson County Air Pollution Control District adopted its emissions trading program on April 21, 1982 (Regulation 2.12). The program was intended to improve air quality. In theory, it applies to stationary source emitting any permitted pollutant. In practice, the program has been utilized for particulates, sulfur dioxide, and VOCs.

CREDITS AND THEIR CREATION

ERCs are any reductions which are real, permanent, surplus, quantifiable, and enforceable. Credits can be created through enforceable reductions or through shutdowns in a contemporaneous period. Reductions from process changes, air pollution control (APC) retrofits, the permitting of unpermitted sources that make a reduction, or the controlling of fugitives are all eligible. The baseline used for ERC calculation is the two highest emission years out of the last five before emission reduction.

ERCs can be applied for up to 10 years after the actual reduction takes place. In practice, most applications are made within two years of reduction.

BANKING PROVISIONS

Restrictions and Limitations

The following apply:

- No minimum deposit is required.

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[1] The information in this section was provided by phone by Dick Everhart on August 2, 1991 (502-625-6000).

- The lifetime of a banked ERC is 10 years, with reversion to the APCD at that time for their use.

- While there are no standard limitations on the use to which banked emissions can be put, there may be specific limitations imposed. For example, in the case of particulates, a permit might specify the height at which particulates can be released. Consequently, the use of an ERC for reduced particulates might be restricted by stack height.

- ERCs do not have to be designated for specific projects.

- Banked ERCs are reduced in quantity by 20% upon use.

- ERCs can only be confiscated or reduced only through special legislative action or through the State Implementation Plan process that might occur if further reductions are required to meet ambient air quality standards or if the measures by which ERCs were created are later mandated.

Application Requirements

Generally speaking, an informal meeting between the Applicant and the District takes place before an application form is completed and filed. In addition to a completed application form, the applicant must also document the emissions baseline on which the reduction is to be based. There is no application fee specific to registration for ERCs. The only fee involved is in the issuance of the Permit to Operate.

Review Process

The review process takes between 60 and 90 days from the submission of a complete application. District review is generally detailed as emissions reductions are verified. At the end of the review process, the permit issuance process begins. The permit issuance process takes approximately one month.

Provision for Public Involvement

While the public is not involved in the review of ERCs for registration, it may be involved in the review of the use of banked or traded credits. This would occur through the new source review process, or through the PSD review process.

Monitoring and Enforcement

Enforcement is accomplished through the Permit to Operate.

Special Banks

There is a provision that a company can designate the recipient of ERCs to be Jefferson County. However, despite this provision, this type of transfer has never occurred.

TRADING PROVISIONS

Requirements and Restrictions

Offsets

- The thresholds that trigger the need for offsets are set in accordance with federal NSR PSD criteria.
- No affected source that exceeds applicable thresholds is exempt from securing offsets.
- The offset ratios are set in accordance with federal guidelines (1.1:1).

Geographic Restrictions

Only offsets within Jefferson County can be traded.

Bubbles

Multi-plant bubbles are not allowed.

Netting

Netting is allowed, but may or may not occur through the bank.

Other

- Shutdown-related ERCs must be contemporaneous with the increase.
- Leasing is allowed.
- Air modelling is generally not required as Jefferson County is in attainment for most pollutants.

Procedure for Transfers

The District is in no way involved in the matching of buyers and sellers. Requested transfers are simply recorded on Permits to Operate. The District keeps a double entry accounting system for internal record keeping.

Liability

Only the creator is liable for emissions in excess of permitted quantities at an ERC source.

AVAILABILITY OF INFORMATION

The bank maintains a public ledger of existing deposits.[2]

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[2] Robert W. Hahn and Gordon L. Hester, "Where Did All The Markets Go? An Analysis of EPA's Emissions Trading Program," *Yale Journal on Regulation*, Volume 6:109 (1989) p. 130.

MARKETING

The District has not marketed this program in any way. However, the local Chamber of Commerce has promoted the program in the past.

BANKING AND TRADING ACTIVITY

Data is not available from the Jefferson County Air Pollution Control District on particular trades that have taken place in Jefferson County. However, it is known that no trades have taken place within the last year.

According to the *Yale Journal of Regulation*[3], as of 1989 some 18 firms had deposited some 26,000 tons per year into the bank. The bank also has provided offsets for nine external and nineteen internal trades.

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[3] Hahn et al., p. 30.

APPENDIX F:
SO_2 ALLOWANCE TRADING PROVISIONS OF THE CLEAN AIR ACT[1]

PROGRAM DESCRIPTION

Title IV of the Clean Air Act (as amended by Public Law 101-549, The Clean Air Act Amendments of 1990 (the Act)) is intended to reduce the adverse effects of acidic deposition by reducing total annual SO_2 emissions by 10 million tons below 1980 levels. The Act mandates a national cap on electric utility SO_2 emissions of 8.95 million tons per year to be achieved in two phases. Phase I, which begins in 1995, will affect the 110 largest, highest emitting utility plants and imposes an intermediate SO_2 limitation requirement. Phase II, which begins in 2000, will impose emissions limitations on nearly all utility units of 25 MW or greater and new utility units in the contiguous 48 states.[2] Nonutility sources will be affected only if they choose to "opt in," that is, to voluntarily reduce SO_2 emissions in order to obtain marketable allowances.

Implementation of Title IV will occur through the issuance and enforcement of operating permits. The rules governing implementation are currently in draft form and include the permits regulation (40 CFR Part 72), the allowance system regulation (40 CFR part 73); the continuous emissions monitoring regulation (40 CFR Part 75) and the excess emissions penalties regulation (40 CFR Part 77).[3] The draft rules are in the process of being reviewed through a series of public meetings of the Acid Rain Advisory Committee—a committee consisting of 44 representatives of industry, government, and interest groups. The rules will also be subject to review and approval by the Office of Management and Budget as well as other government agencies before they can be officially proposed by the Environmental Protection Agency in September 1991. Final rules are scheduled for May 1992.[4] The following summary of the allowance trading program and related provisions describes the program as it is currently drafted. Provisions are subject to change.

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[1] Unless otherwise noted, the source for this section is a personal conversation with Claire Schary, Environmental Protection Specialist, Environmental Protection Agency Acid Rain Division (7/17/91).

[2] Certain qualifying small power production facilities, qualifying cogeneration facilities, and independent power producers are exempt.

[3] The draft opt-in rule is not expected until late 1991.

ALLOWANCES AND THEIR ALLOCATION

An "allowance" is an authorization allocated to an affected unit to emit one ton of sulfur dioxide in a given calendar year (Section 402). An allowance does not create property rights, rather, it is a limited authorization to emit. Allowances may be used, banked, or temporarily or permanently transferred.

Generally speaking, allowances will be allocated by EPA to utility units in operation as of the date of the Amendments. The number of allowances per unit is specified in the Act for Phase I, and a formula for calculation of the number of allowances per unit is specified for Phase II.[5] The baseline used for existing utility units is the average annual quantity of mmBtus consumed in fuel during 1985–1987 as recorded with DOE. Where that information is not available, the baseline is the level specified in the 1985 National Acid Precipitation Assessment Program (NAPAP). The baseline for new utility units will be zero—an allowance will be required for each ton of sulfur dioxide emitted. For nonutility units, the baseline will be determined by NAPAP data. The allowances will be allocated free of charge.

Even though an affected unit is allocated a fixed number of allowances in accordance with its baseline emissions, it will not necessarily receive its full allocation. For example, EPA will withhold 2.8% of Phase I allocations in Phase I, and 2.8% of Phase II allocations in Phase II for distribution through auctions and direct sales. The proceeds from these sales will be distributed to the original allowance holders. EPA will also reduce Phase II allowance allocations to create certain allowance reserves. EPA may also reduce Phase II allocations in order to meet the 8.9 million ton annual cap on emissions.[6]

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[4] "EPA Says Its Acid Rain Rules Will Make Trading 'Easy and Attractive,'" *Electric Utility Week* (7/15/91), p. 11.

[5] Katten, Muchin, and Zavis, *Bulletin* (November 1990), p. 5.

[6] Lock et al., *The New Clean Air Act: Compliance and Opportunity,* Public Utility Reports Inc. (1991), p. 22.

While the number of total allowances is fixed, unallocated or un-used allowances as well as the allowances held in reserves can be obtained under certain conditions through the following means:

- Installation of scrubbers at utilities units specified under the law;
- A purchase from utilities or others holding unutilized allowances;
- A purchase from a fixed price ($1500 per allowance) reserve held by EPA;
- A purchase from the auction system, which, beginning in 1993, will make available (by sealed bid) the 2.8% of the allowances allocated to existing units but held in a special reserve by EPA;[7]
- Early compliance with Phase II requirements in the years 1995–1999;[8]
- Use of energy conservation and renewable energy in order to obtain (on a first come, first served basis) some of the 300,000 allowances (up to 30,000 annually) scheduled to be set aside for this purpose.[9]

BANKING PROVISIONS

Conditions for Storage

Anyone who owns an allowance will be able to establish an account with the bank. Affected sources will have accounts established automatically. EPA will provide for the automatic debiting of affected sources' allowance accounts based upon monitoring and compliance data received. Unused allowances in any owner's account will remain "banked." There will be no minimum deposit required and no limit to credit lifetime. A deposited allowance can be saved indefinitely until used or transferred as desired. However, allowances from future years can not be utilized early.

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[7] Katten et al., p. 6.

[8] Lock et al., p.26.

[9] Qualifying criteria apply, including the utility having in place a least-cost plan.

Provisions for Reduction in Quantity

While the Act allows EPA to reduce the number of total annual allowances, at this time EPA has no plans to do so.

TRADING PROVISIONS

Requirements and Restrictions

Eligibility

Any person who owns an allowance as well as the designated representatives for affected units will be able to sell allowances. However, a limited number of allowances (such as those allocated to a unit installing repowering technology) have restrictions on their trade.

Geographical Restrictions

There are no geographical restrictions proposed for limiting trades. If any such restrictions are implemented, they will occur at the state level.[10]

Inter-Pollutant Trading

By January 1994 EPA will provide to Congress a study evaluating the consequences of amending Title IV to allow trading sulfur dioxide allowances for nitrogen oxides allowances (Section 403).

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[10] Florida, for example, is considering prohibiting interstate trades.

Multi-Unit Provisions

Where more than one unit's emissions flow through a single stack, EPA will aggregate the units' allowances for the purpose of determining compliance.[11] However, this is not to be confused with a "bubble" approach. Compliance with the Act is to be based exclusively on unit-by-unit emissions and allowance holdings.[12] If allowances are exceeded, all of the units are treated as being out of compliance.

Units within a utility system or power pool can opt to pool allowances if certain conditions are met. Under a pooling arrangement, temporary increases or decreases in emissions levels would not require allowance transfers, provided that the total emissions in the pool do not exceed the total allowances held. Again, long-term compliance is based upon unit-by-unit emissions and if total allowances are exceeded, all of the pooled units are treated as being out of compliance.

True-Up Period

A true-up period is proposed for the end of a calendar year, where sources who have emitted in excess of their allowances have some period of time (currently proposed in the draft rule as 30 days) to acquire allowances to make up the deficit, and those sources who have emitted less than their allocation can sell.

Liability

To date, EPA has adopted a position of "buyer beware," where it is the buyer's responsibility to make sure the seller actually owns the allowances offered for sale. Once ownership is transferred, however, the buyer is not responsible if the seller's emissions exceed his remaining allocation.

Opt-in allowances, however, are likely to be more risky. Current thinking is that if allowances allocated to an opt-in unit are sold and the opt-in unit subsequently shuts down, the allowances would be considered void and the buyer forced to surrender them.[13]

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[11] EPA, "OMB/ATAC DRAFT" (6/21/91), p. 111.

[12] EPA, p. 107.

ADMINISTRATIVE PROCESS

Designated Representative

One designated representative is required for each designated source (which might consist of multiple units). That designated representative will exclusively interact with the Agency on permit- and allowance-related matters. The designated representative's actions will be binding on the units' owners. Further, this representative will be personally responsible for ensuring that his represented source is permitted and in compliance.

Forms

As currently proposed, there are four simple (one-page) forms that would be used in conjunction with the banking program: a compliance deduction form, a designated contact form, an opt-in form, and a transfer-of-allowance-ownership form. The compliance deduction form allows the designated representative of an affected unit to specify which particular allowances in an account should be used for compliance purposes (allowances may have been acquired at different costs, consequently there are accounting and tax liability implications). The designated contact form represents an agreement of an affected unit's owners who the unit's representative to EPA will be. The opt-in form will allow nonutility units to register their units as affected units for the purpose of creating marketable allowances. And the transfer-of-allowance-ownership form will provide EPA with the information necessary to transfer allowances between designated accounts.

Fees

There are no fees for utilization of the bank. The only potential fees are in the application for operating permits. Until the year 2000, operating permits will be issued by EPA and no fee will be charged. After that permitting will be done at the state level and states will be allowed to charge fees to recover their expenses.

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[13] "Notes from the Acid Rain Advisory Committee Allowance Trading Subcommittee Meeting April 29-30, 1991," p. 7.

Timing

EPA proposes to record allowance transfers within five business days of receiving the allowance transfer forms. There is no proposed time limit on the filing of the forms, except that it is proposed that allowance transfers must be submitted for recordation to EPA by January 30 of the calendar year following the year of the allowance's use.[14] EPA will have one month to record transfers and to resolve any associated disputes.[15] Claims of error in the recordation of allowance transfers must be made within 10 days of EPA's notice of the recordation of the transfer.[16]

MONITORING AND ENFORCEMENT PROVISIONS

EPA has proposed that continuous emissions monitors (CAM) serve as the primary monitoring means.[17] A statutory base penalty of $2000 per ton of SO_2 in excess of an affected unit's emissions limitation will be assessed. The annual allowance account for that unit will also be reduced by the amount of the violation. In addition, units in violation will have to prepare excess emissions offset plans by February 28 of the year following violation.[18]

The rules as currently proposed require that owners and operators of an affected unit be held jointly and severally liable for violations.[19] The unit's designated representative as well as the multiple owners will also be held liable for any violations.

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[14] EPA, p. 108.

[15] EPA, p. 108.

[16] EPA, p. 113.

[17] "EPA says . . . ," p. 11.

[18] EPA, p. 108.

[19] EPA, p. 13.

AVAILABILITY OF INFORMATION

The current draft rules indicate that EPA will not compile data on prices and the nature of allowance trading transactions because it feels it would result in unnecessary costs and processing delays.[20] However, EPA will establish a tracking system for recording allowance transfers. EPA is proposing to make all of the information in the allowance tracking accounts available to the public.[21]

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[20] "EPA Says...," p. 11.

[21] EPA, p. 114.

APPENDIX G:
NO_x/VOC TRADING FEASIBILITY ASSESSMENT FOR THE LOWER FRASER VALLEY

This appendix assesses the feasibility of emissions trading for NO_x and VOCs in the Lower Fraser Valley.

INSTITUTIONAL STRUCTURE

The Greater Vancouver Regional District (GVRD) administers air quality on behalf of the B.C. Ministry of Environment for most, but not all, of the Lower Fraser Valley. Our discussion of the feasibility of emissions trading will be based on the regulations of the GVRD. If an emissions trading system is instituted in the Lower Fraser Valley, it can be implemented first in the GVRD and subsequently be extended to the remainder of the region. Extension of the emissions trading system could occur through extension of the air quality management authority of the GVRD to the entire Lower Fraser Valley or through adoption of identical rules in the balance of the region by the Ministry of Environment and then allowing trades to occur between jurisdictions in the Lower Fraser Valley.

SCOPE

Our assessment of the feasibility of emissions trading for the Lower Fraser Valley is limited to point sources of NO_x and VOCs. Mobile and area sources of NO_x are excluded as are mobile, area and gasoline marketing sources of VOCs. Other atmospheric pollutants are not addressed in our feasibility assessment for emissions trading.

TOTAL EMISSIONS

Current and forecast emissions of NO_x and VOCs in the Lower Fraser Valley are shown in Table G-1. Total emissions are shown for each source category as estimated for 1985 and forecast for 2005 by the GVRD Air Management Plan.

It is clear from Table G-1 that mobile sources dominate both NO_x and VOC emissions in the Lower Fraser Valley. Mobile source emissions are forecast to decline despite the growth in vehicular traffic as emission control equipment is phased into the vehicle fleet. Point sources, which are generally the most amenable to trading programs, represent 10% to 15% of VOC emissions and 15% to 25% of NO_x emissions. Point source emissions of both NO_x and VOCs are forecast to rise over the period to 2005.

Table G-1
NO_x AND VOC EMISSIONS IN THE LOWER FRASER VALLEY
1985 and 2005

	1985		2005		Change
	tonnes	%	tonnes	%	%
NO_x					
Mobile Sources	39,263	78.2	36,580	65.9	-6.8
Point Sources	8,282	16.5	15,262	27.5	+84.3
Area Sources	2,687	5.3	3,634	6.6	+35.2
TOTAL	50,232	100.0	55,476	100.0	+10.4
VOCs					
Mobile Sources	47,398	60.9	30,102	43.8	-36.5
Point Sources	6,997	9.0	9,712	14.1	+38.8
Area Sources	17,245	22.2	20,201	29.4	+17.1
Gasoline Marketing	6,176	7.9	8,707	12.7	+41.0
TOTAL	77,816	100.0	68,722	100.0	-11.7

Source: B.H. Levelton & Associates Ltd., and Concord Scientific Corporation, *GVRD Air Management Plan—Stage I: Assessment of Current and Future Air Quality,* Vancouver, September, 1989, Table 4.4, pp. 4–28.

The figures in Table G-1 are substantially lower than the estimates presented in the NO_x/VOC Management Plan. The figures in the Management Plan are:[1]

	1985	2005
NO_x (kilotonnes)	92.7	67.8
VOC (kilotonnes)	114.0	104.9

The different estimates of NO_x and VOC emissions can be attributed to the different methodologies used. The Environment Canada estimates reported in the NO_x/VOC Management Plan are developed using a "top-down" approach. National and regional emissions estimates are scaled down to the Lower Fraser Valley using population and economic activity factors. The GVRD figures are based on a "bottom-up" approach where the emissions for each specific source or source category are calculated using source-specific information. The top-down approach may start with an inaccurate base and may use inappropriate scaling factors. The bottom-up approach may miss sources and may not have accurate information for all the sources covered.

The GVRD will compile a comprehensive inventory of emissions for the Lower Fraser Valley for 1990 beginning this fall. The inventory will be completed by mid-1992. It will be another "bottom-up" inventory that can be compared to the 1985 inventory for consistency. It will not necessarily explain the difference between the Environment Canada and GVRD estimates.

POINT SOURCE EMISSIONS OF NO_x AND VOCs

The GVRD's 1985 emissions inventory for the Lower Mainland includes 351 point sources. Many of these sources have multiple stacks or emissions sources. In total there are at least 2,000 sources that will need to be controlled if atmospheric emissions from point sources are to be reduced. The 1985 emissions by point sources in each industry group are shown in Tables G-2 and G-3.

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[1] Canadian Council of Ministers of the Environment, *Management Plan for Nitrogen Oxides (NOx) and Volatile Organic Compounds (VOCs) Phase I*, Winnipeg, November 1990, Tables 14 and 15, pp. 144, 145.

Table G-2
SO$_X$, PARTICULATE, AND CO EMISSIONS BY INDUSTRY GROUP
(1985)

2-Digit SIC	SO$_x$			Particulates			CO		
	# Facil	kg/yr	% of Ttl	# Facil	kg/yr	% of Ttl	# Facil	kg/yr	% of Ttl
01	2	707	0.01%	2	21,050	0.10%	2	44,152	0.34%
02	0	0	0.00%	1	4,268	0.02%	0	0	0.00%
08	0	0	0.00%	0	0	0.00%	0	0	0.00%
10	19	37,421	0.42%	21	640,725	2.93%	20	28,265	0.22%
11	5	16,179	0.18%	5	65,031	0.30%	5	16,125	0.12%
15	3	63	0.00%	3	70,134	0.32%	3	428	0.00%
16	2	221	0.00%	6	62,822	0.29%	2	1,505	0.01%
25	57	33,093	0.37%	84	10,487,844	48.01%	57	9,410,371	72.90%
26	3	316	0.00%	8	147,395	0.67%	3	15,319	0.12%
27	11	79,525	0.90%	12	2,882,765	13.20%	11	275,769	2.14%
28	1	23	0.00%	3	33,785	0.15%	1	157	0.00%
29	20	22,584	0.26%	26	391,835	1.79%	19	11,647	0.09%
30	10	21,743	0.25%	16	388,529	1.78%	10	94,750	0.73%
32	4	576	0.01%	5	32,821	0.15%	4	13,345	0.10%
33	5	8,783	0.10%	8	47,705	0.22%	4	3,765	0.03%
35	19	3,721,596	42.09%	39	2,426,255	11.11%	19	2,109,698	16.34%
36	13	4,845,909	54.81%	18	1,138,398	5.21%	12	851,875	6.60%
37	7	50,134	0.57%	12	49,245	0.23%	6	25,896	0.20%
42	0	0	0.00%	0	0	0.00%	0	0	0.00%
45	3	275	0.00%	3	289,074	1.32%	3	320	0.00%
47	5	158	0.00%	6	2,577,039	11.80%	5	1,085	0.01%
49	1	212	0.00%	6	27,296	0.12%	1	1,448	0.01%
51	0	0	0.00%	1	180	0.00%	0	0	0.00%
56	0	0	0.00%	1	760	0.00%	0	0	0.00%

Table G-2 (continued)
SO_X, PARTICULATE, AND CO EMISSIONS BY INDUSTRY GROUP
(1985)

2-Digit SIC	SO_x			Particulates			CO		
	# Facil	kg/yr	% of Ttl	# Facil	kg/yr	% of Ttl	# Facil	kg/yr	% of Ttl
59	2	99	0.00%	3	40,230	0.18%	2	678	0.01%
62	0	0	0.00%	1	4,120	0.02%	0	0	0.00%
63	1	1,024	0.01%	1	4,515	0.02%	1	993	0.01%
77	1	55	0.00%	2	4,065	0.02%	1	563	0.00%
86	0	0	0.00%	1	2,471	0.01%	0	0	0.00%
91	1	1,048	0.01%	1	51	0.00%	1	128	0.00%
97	1	5	0.00%	1	4,044	0.02%	1	37	0.00%
	196	8,841,750	100.0%	296	21,844,451	100.0%	193	12,908,319	100.0%

Table G-3
NO_X AND VOC EMISSIONS BY INDUSTRY GROUP
(1985)

2-Digit SIC	NO_x			VOC		
	# Facil	kg/yr	% of Ttl	# Facil	kg/yr	% of Ttl
01	2	8,179	0.09%	2	4,498	0.06%
02	0	0	0.00%	0	0	0.00%
08	0	0	0.00%	0	0	0.00%
10	21	262,733	3.01%	20	6,208	0.08%
11	5	150,214	1.72%	5	2,882	0.04%
15	3	4,402	0.05%	3	116	0.00%
16	2	15,476	0.18%	6	278,415	3.60%
25	57	613,265	7.03%	49	948,948	12.28%
26	3	17,769	0.20%	3	213,044	2.76%
27	11	604,931	6.94%	11	221,604	2.87%
28	1	1,616	0.02%	2	58,386	0.76%
29	20	94,872	1.09%	20	104,296	1.35%
30	10	170,467	1.95%	13	131,043	1.70%
32	4	37,255	0.43%	4	4,162	0.05%
33	4	38,722	0.44%	5	15,960	0.21%
35	19	4,292,890	49.22%	20	69,847	0.90%
36	12	2,090,969	23.97%	12	5,427,985	70.23%
37	6	268,055	3.07%	7	211,797	2.74%
42	0	0	0.00%	0	0	0.00%
45	3	2,836	0.03%	4	5,167	0.07%
47	5	11,153	0.13%	5	191	0.00%
49	1	14,893	0.17%	1	255	0.00%
51	0	0	0.00%	0	0	0.00%
56	0	0	0.00%	0	0	0.00%
59	2	6,974	0.08%	2	119	0.00%
62	0	0	0.00%	0	0	0.00%

Table G-3 (continued)
NO_x AND VOC EMISSIONS BY INDUSTRY GROUP
(1985)

2-Digit SIC	NO_x			VOC		
	# Facil	kg/yr	% of Ttl	# Facil	kg/yr	% of Ttl
63	1	9,223	0.11%	1	178	0.00%
77	1	3,788	0.04%	1	64	0.00%
86	0	0	0.00%	0	0	0.00%
91	1	568	0.01%	1	25	0.00%
97	1	375	0.00%	1	23,903	0.31%
	195	8,721,623	100.00%	198	7,729,092	100.0%

Almost 195 of the point sources contribute NO_x emissions. The six largest sources are two cement plants and the four oil refineries. The cement plants each account for over 10% of total point source NO_x emissions. Each oil refinery contributes between 4% and 9% of total point source NO_x emissions. In aggregate the six sources contribute 62.5% of total point source NO_x emissions.[2] The distribution of NO_x emissions by source is shown in Figure G-1.

There is another large source, BC Hydro's Burrard Generating Station. It did not operate during 1985 and so does not appear in the emissions inventory. The 900 MW generating station is currently permitted to emit 2,200,000 kg of NO_x per year.

Roughly 198 of the sources have VOC emissions. The four largest sources are the four oil refineries. Each is responsible for over 12% of total VOC emissions from point sources. Together the four refineries are responsible for 70.2% of total VOC emissions from point sources. No other firm accounts for more than 2.5% of total VOC emissions from point sources. The distribution of VOC emissions by source is shown in Figure G-2.

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[2] The two cement plants and four oil refineries are also the dominant sources of SO_x emissions, being responsible for 94.7% of total point source SO_x emissions.

Figure G-1

NO_x Emissions by Size of Source

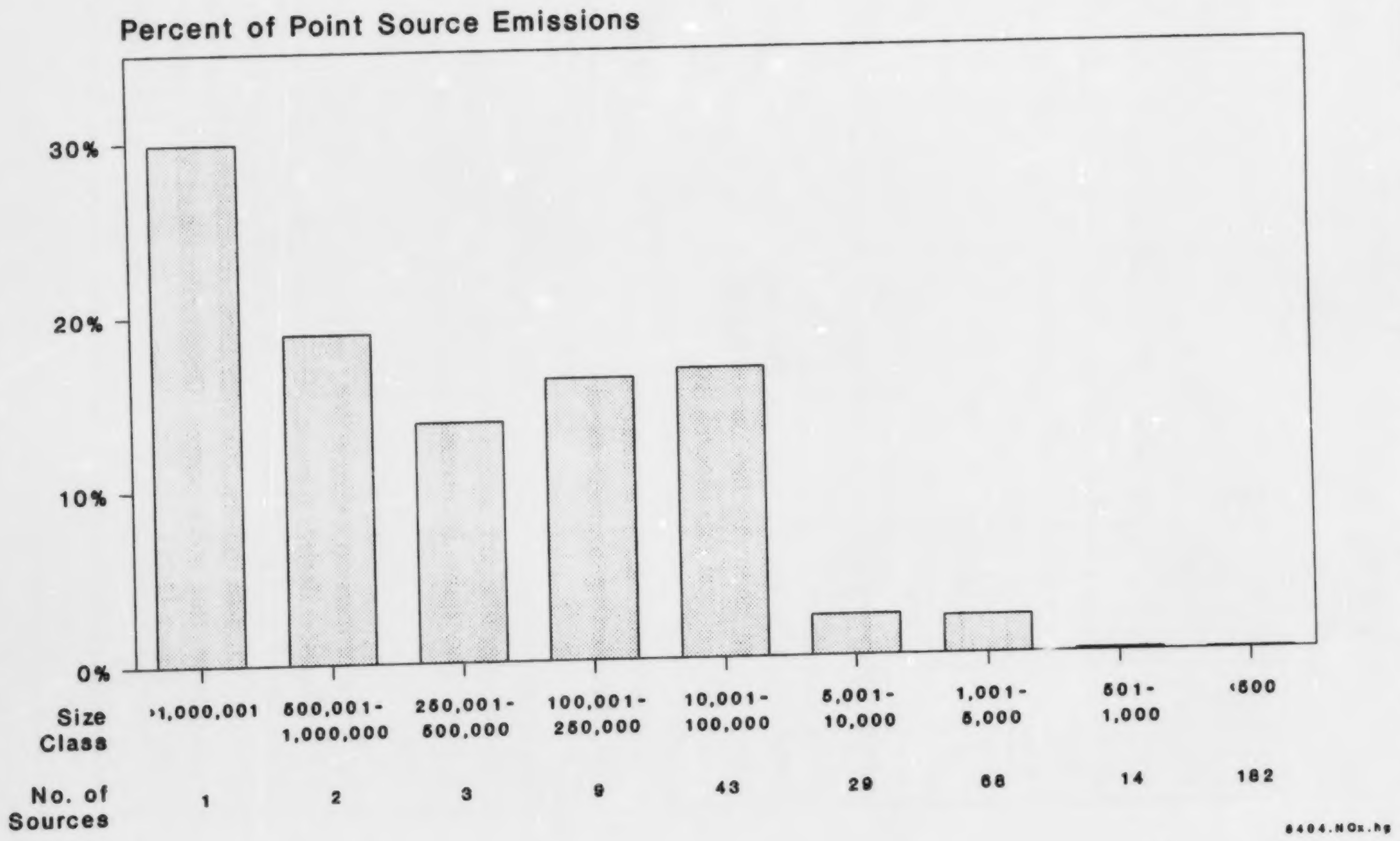
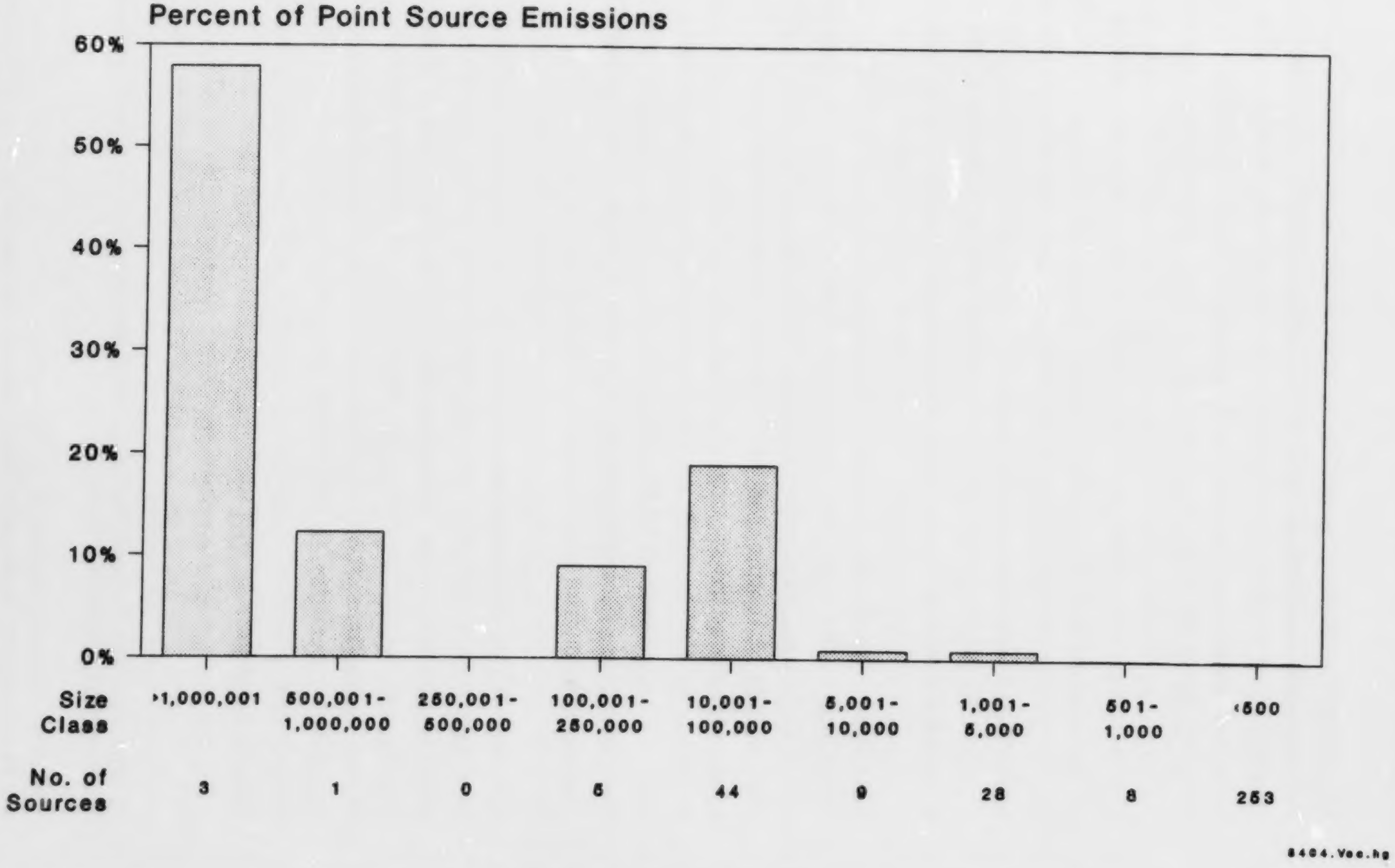


Figure G-2

VOC Emissions by Size of Source



OBJECTIVES FOR NO_x AND VOC EMISSIONS REDUCTIONS

The objective adopted by the Board of Directors of the GVRD is to reduce "by 50% the total emissions of sulphur and nitrogen oxides, particulates, carbon monoxide and volatile organic compounds by the year 2000."[3] Emissions of the individual gases could be lowered by varying amounts as long as total emissions of all of the gases are halved.

The NO_x/VOC Management Plan adopted by the Canadian Council of Ministers of the Environment establishes reduction targets for NO_x and VOC emissions in the Lower Fraser Valley. Phase I of that plan calls for 40% reductions in the 1985 emissions of both NO_x and VOCs in the Lower Fraser Valley by 2005.[4] We will assume that the target emissions reduction for both NO_x and VOCs is 40% although the precise figure is not critical to the feasibility assessment.

We assume that the air management plan implemented to achieve the 40% reductions in NO_x and VOC emissions will seek to achieve roughly proportional reductions across all source categories; point sources, area sources, mobile sources and gasoline marketing sources. Thus we assume that the point sources covered by the emissions trading program would need to reduce their 1985 aggregate NO_x emissions by 40% by 2005. And they would need to achieve a similar reduction in their 1985 aggregate of VOC emissions. The aggregate reduction means that total emissions from all existing and new point sources in 2005 are 40% lower than the total emissions from point sources existing in 1985.

We assume that the emissions reductions by the source categories outside the emissions trading system will be achieved through conventional command-and-control measures. Emissions trading for NO_x and/or VOCs would augment existing command-and-control measures for point sources. Depending on the type of trading program instituted, new command-and-control measures might be mandated for existing, modified and new point sources. Other trading program designs can, in principle, obviate the need for any additional command-and-control measures.

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[3] Greater Vancouver Regional District, *Creating Our Future: Steps to a More Livable Region*, Vancouver, B.C., September 1990, page 13.

[4] Canadian Council of Ministers of the Environment, *Management Plan for Nitrogen Oxides (NO_x) and Volatile Organic Compounds (VOCs) Phase I*, Winnipeg, November 1990, Tables 14 and 15, pp. 144, 145.

OZONE EPISODES

Low-level ozone is a seasonal problem in the Lower Fraser Valley; concentrations are highest between March and September.[5] In addition, some types of weather conditions give rise to ozone episodes during which ozone concentrations exceed the federal government's Maximum Acceptable Objective for one-hour average concentration.[6] These episodes can generally be forecasted 24 hours in advance and typically last one or two days per episode. In most years there are fewer than ten episodes.

Analysis of five selected ozone episode days reported in the GVRD Air Management Plan found that, with no restrictions on NO_x emissions, the predicted reductions in VOC emissions required to attain the ozone design value of 0.082 ppm ranged from 43% to 73% based on 1985 emissions levels. The U.S. EPA's recommended procedure is to adopt as the reduction required for the air basin, the VOC reduction that will ensure that no more than three one-hour ozone concentrations exceed the ambient standard in any three-year period. If the ozone objective were expressed according to the U.S. definition, the analysis implies a 43% reduction in current VOC emissions for the GVRD. A target based on ensuring that the one-hour ozone concentration standard is never exceeded would require a 73% reduction in VOC emissions.

The NO_x/VOC Management Plan establishes Phase I reduction targets of 40% for both NO_x and VOC emissions in the Lower Fraser Valley. Specifically, the Management Plan proposes that NO_x emissions be reduced from 92.7 kt in 1985 to 55.0 kt in 2005 (40% reduction) and that VOC emissions be lowered from 114.0 kt in 1985 to 69.2 kt in 2005 (40% reduction). The NO_x/VOC Management Plan indicates that to reach the Maximum Acceptable Objective of 0.082 ppm a 50% to 60% reduction would be required in the Lower Fraser Valley.[7] Initiatives beyond those proposed in Phase I will be adopted to realize the additional reductions.

The NO_x/VOC Management Plan states that "combined NO_x and VOC emissions would be most effective in reducing peak ozone concentrations in the GVRD and

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[5] GVRD Air Management Plan, Figure 3.7, page 3-17.

[6] GVRD Air Management Plan, Figure 3.8, page 3-18.

[7] Management Plan for Nitrogen Oxides (NO_x) and Volatile Organic Compounds (VOCs) Phase I, page 48.

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We assume that the emissions reductions by the source categories outside the emissions trading system will be achieved through conventional command-and-control measures. Emissions trading for NO_x and/or VOCs would augment existing command-and-control measures for point sources. Depending on the type of trading program instituted, new command-and-control measures might be mandated for existing, modified and new point sources. Other trading program designs can, in principle, obviate the need for any additional command-and-control measures.

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[3] Greater Vancouver Regional District, *Creating Our Future: Steps to a More Livable Region*, Vancouver, B.C., September 1990, page 13.

[4] Canadian Council of Ministers of the Environment, *Management Plan for Nitrogen Oxides (NO_x) and Volatile Organic Compounds (VOCs) Phase I*, Winnipeg, November 1990, Tables 14 and 15, pp. 144, 145.

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The NO_x/VOC Management Plan states that "combined NO_x and VOC emissions would be most effective in reducing peak ozone concentrations in the GVRD and downwind areas of the Fraser Valley."[8] This differs from the GVRD Air Management Plan, which reports that the most efficient means of achieving the design level of ozone control is through VOC reductions alone.[9] At a minimum, further research and modelling is needed before greater NO_x and/or VOC emissions reduction requirements to deal with ozone episodes can be defined.

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[5] GVRD Air Management Plan, Figure 3.7, page 3-17.

[6] GVRD Air Management Plan, Figure 3.8, page 3-18.

[7] Management Plan for Nitrogen Oxides (NO_x) and Volatile Organic Compounds (VOCs) Phase I, page 48.

COMMON FEATURES OF TRADING PROGRAMS

We consider two designs for an emissions trading program:

- An emissions reduction credit approach
- A tradeable allowance approach

Under the emission reduction credit approach, command-and-control measures are mandated for existing, modified and new point sources to achieve the target reduction in emissions. The trading program is intended primarily to offset residual emissions from new and modified sources so that air quality does not deteriorate. Under the tradeable allowances approach, no new command-and-control measures would be instituted for point sources. The target reduction in emissions would be achieved by reducing the total quantity of allowances by 40% and requiring all existing and new point sources to acquire allowances equal to their total emissions.

Regardless of the design chosen for the NO_x or VOC emissions trading system, the following matters must be addressed:

- An historic emissions level must be established for each point source. This level serves as the base from which emission reduction credits are calculated or to determine the proportion of allowances allocated to each source. Definition of the historic emissions level is a policy choice, but the most obvious candidates appear to be the 1990 emissions inventory, the 1985 emissions inventory, or average emissions for a two- or three-year period within the past five years.[10]

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[8] Management Plan for Nitrogen Oxides (NO_x) and Volatile Organic Compounds (VOCs) Phase I, page 47.

[9] B. H. Levelton & Associates Ltd. and Concord Scientific Corporation, *GVRD Air Management Plan —Stage I: Assessment of Current and Future Air Quality*, Vancouver, September 1989, pp. 5–9.

- New sources have an historic base of zero. They must acquire allowances equal to their total emissions or install emission controls and acquire emission reduction credits to offset any residual emission.

- Threshold levels need to be defined. New sources or modifications to existing sources with emissions above the threshold level must acquire emission reduction credits or allowances to cover their emissions. Threshold levels are a policy matter, but the trend is toward low threshold levels and serious consideration should be given to using threshold levels of zero.

- An emissions bank should be established to facilitate trading. With an allowance system the GVRD would track the allowances issued to, and sold, purchased, and used by each source. Making this information available to the public will facilitate trading activity. With an emission reduction credit system, new and expanding sources must find offsets; an emissions reduction credit bank makes that process much easier. Sources must be confident that their banked allowances/credits will not be discounted or confiscated by the regulatory authority as a means of achieving the air quality target.

- A community bank should be established to provide allowances/emission reduction credits to new and expanded public-sector, and possibly small private-sector, point sources. Exact definition of the sources that could draw on the community bank is a policy issue. Determination of contributions to the community bank is another policy choice, but the most common approaches are a small mandatory contribution as part of each transaction, a requirement for each source to overcontrol by a small amount, and use of the offset margin.

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[10] The problem with choosing a specific year is illustrated by the fact that one of the large sources, BC Hydro's Burrard Generating Station, does not appear in the 1985 emissions inventory because it did not operate that year.

- Establish offset ratios for trades. Allowance trading is expected to occur on a one-to-one basis; one tonne of allowances for each tonne of emissions. Trades of emission reduction credits almost always involve a greater than one-to-one offset emission reduction credits of more than one tonne for one tonne of additional emissions. The detailed offset provisions are policy decisions.

- Establish geographic restrictions on trades. It may be desirable to restrict trades of credits or allowances into areas within the Lower Fraser Valley that experience relatively high ozone concentrations. Given the prevailing west to east winds, a restriction on trades that shift emissions to the west might also be considered. If the east to west restriction is too stringent, sources on the coast will have no option but to install controls, making the trading system "unfair" for those firms. Details of the geographic restrictions on trades are policy matters.

- Specify the monitoring, recordkeeping and reporting requirements. The permit for each point source must include conditions that require installation of appropriate monitoring equipment and maintenance of the records needed to report actual emissions to the GVRD with a specified level of accuracy.

- Clearly define the responsibilities of each emitter. Typically these responsibilities include ensuring compliance with permit conditions, ensuring that monitoring and control equipment are in good working order, maintenance of accurate records, and timely reporting of emissions to the GVRD.

- Create a credible enforcement threat with significant penalties. Violators must face a significant probability of being detected and penalized. The GVRD's enforcement program must be effective and be sufficiently large and visible to deter potential violators. The penalties must also be sufficiently severe to have a deterrent effect. With an allowance system a financial penalty can be combined with the requirement to acquire allowances equal to the excess emissions. An emissions reduction credit system usually has only financial penalties. Penalties for administrative violations—inaccurate records, etc.—must be sufficiently stringent that such violations are not used to disguise noncompliance. The penalties for specific violations are a matter of detailed program design and agency policy.

- Implement a fee structure that generates sufficient revenue to administer the program. The GVRD air quality management budget and fee structure are administrative matters. It is premature to deal with them at this feasibility assessment stage.

- Administer the trading program efficiently and predictably. Clear rules, consistent decisions and predictable processing times are requirements for a successful trading program. It helps if the administrative processes are simple, fast and inexpensive, but predictability and consistency are more important.

- Provide mechanisms for public participation in the development and administration of the emissions trading program. Many programs require publication of public notice of, and provide an opportunity for public objection to, proposed trades above a minimum size. The details of the public participation process are matters of policy.

- Seek the input of all stakeholders in the development of the trading program. A program that best meets the needs of all stakeholders stands the best chance of success.

- Allow opting-in if possible. We have assumed that the trading program applies only to point sources, while all other sources are covered by traditional command and control measures. If indirect sources or gasoline marketing sources can be issued permits and meet the monitoring and reporting requirements, they should be allowed to opt-in to the trading system. Opting-in would be subject to approval on a case-by-case basis. Opt-in provisions increase the number of potential sources participating in the market and expand the range of control options (and control costs) faced by the sources in the market.

- Address interpollutant trading. Interpollutant trading is a policy option. Where it is allowed in emission reduction credit trading programs, it is usually tightly constrained. Interpollutant trading between NO_x and SO_2 must be examined by the EPA under Title IV of the 1990 Clean Air Act amendments. Title I of the same law requires the EPA to study the feasibility and potential for NO_x and VOC trading. Interpollutant trading is an integral component of the tradeable permit system for ozone depleting substances.

TRADING PROGRAM OPTIONS

Two options are possible for design of an NO_x or VOC trading program. They are based on the emissions reduction credit and allowance trading programs found in the U.S. Each of these options is discussed in turn.

Emission Reduction Credit Program

With an emission reduction credit program the emissions reductions are achieved primarily through command-and-control measures imposed on existing, modified and new sources. Netting provisions facilitate compliance by existing sources. Emission reduction credits are created and traded primarily to facilitate economic growth that leads to expansion of existing sources or establishment of new sources.

Under this option the GVRD would mandate emission reduction and control measures for all existing, modified and new point sources. The measures would be chosen to achieve the target reduction; 40% for NO_x and VOCs as specified in the NO_x/VOC Management Plan or such other targets as the GVRD Board of Directors might set to achieve their goal of an overall reduction of 50% for all common air pollutants.

New and modified sources whose emissions, after implementing all of the mandated reduction and control measures, exceed the established threshold would purchase emission reduction credits from existing sources (directly or indirectly via the emissions bank) to at least offset their residual emissions. The specific offset requirement and any geographic restrictions on the source of the credits would be established by policy.

The buyers are new and modified point sources whose residual emissions exceed the specified threshold. The sellers are existing point sources that have reduced their emissions beyond the required level. With opting-in provisions, non-point sources can also become sellers.

Netting, trades between sources within the same facility, would also be allowed. In such transactions a single firm is both the buyer and seller. Bubbles could also be allowed. However, assessing bubbles is a more complex proposition because they may involve different locations. Where allowed in the U.S. they are not used frequently. It may be simpler not to have a bubble provision; a firm could still create a credit at one site and "sell" it to another site. The existence of a bubble provision is a policy option.

Tradeable Allowance Program

Under a tradeable allowance approach each point source is allocated allowances in proportion to its historic emissions level (or on the basis of some other agreed-on formula). An allowance represents, say, one tonne of NO_x, which can be emitted at any future date. The total quantity of allowances issued each year declines gradually to the target quantity (e.g., 40% less than the 1985 level) in 2005. Each source must provide the GVRD with allowances equal to the actual emissions it reports quarterly or annually.

Since the total quantity of allowances issued is less than the total emissions in the base year, there will not be enough allowances to enable all sources to comply without implementing some control measures. Some sources must implement measures to reduce their emissions. They will probably implement measures that reduce emissions below the quantity of allowances they currently hold because their future allocations of allowances will be lower still. The surplus allowances can be banked for future use or be sold to other point sources that have not yet implemented emissions reduction measures.

Although we have assumed that no additional command-and-control requirements would be imposed on point sources under a tradeable allowances type of program, that need not be the case. Mandated controls are not needed and reduce the potential economic savings from trading, but are not incompatible with an allowance trading system. However, as more stringent controls are imposed on each source, it has less discretion and less opportunity to trade.

Seasonal Allowances Are a Possibility

Ozone is primarily a summertime problem in the Lower Fraser Valley and control of VOC emissions is the best means of managing the problem. With VOC allowance trading, point sources participating in the program could be given summer allowances and winter allowances. Given the seasonal nature of the ozone problem, the quantity of winter emissions allocated could be kept at 100% of the base year emissions while the summer emissions allocated decline to the target level, i.e., 60% of the base year level with a 40% reduction target.[11] Winter allowances could only offset winter emissions, while summer allowances could offset either summer or winter emissions. Summer would be defined as April through September (or some other appropriate period).

This system might open up additional control options for VOC sources. On the other hand, since emissions control systems can be operated continuously, there may be very little economic advantage to a seasonal allowance system. The decision to consider a seasonal allowance system clearly is a policy matter. If it is an acceptable option, stakeholder consultation is essential before it is adopted.

OZONE EPISODES

An emissions trading program for NO_x and/or VOCs would in itself do nothing to limit (or aggravate) the frequency of ozone episodes nor to restrict emissions during such periods. It is possible that the objective of a 40% reduction of emissions of both NO_x and VOCs from all sources may be sufficient to virtually eliminate ozone episodes that exceed the Maximum Acceptable concentration. However, it may be prudent to restrict VOC emissions during ozone episodes.

An ozone episode would be a period of predefined duration (e.g., 8, 12 or 24 hours) and prior notification (e.g., 12 or 24 hours) would be needed to invoke this restriction. To establish the maximum VOC emission rate during an episode requires further modelling, but current evidence suggests that it need not be much more stringent, if at all, than the target 40% reduction. In that case the maximum daily emission rate could be calculated as 60% of the base year VOC emissions divided by 365. This restriction on emissions during ozone episodes could be introduced as a permit condition.[12]

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[11] Assuming that the summer and winter periods are each defined as six months, the base year emissions would be divided equally to get the winter base and summer base.

It must be remembered that point sources are responsible for less than 15% of the VOC emissions in the Lower Fraser Valley. To deal effectively with ozone episodes it will be necessary to limit emissions from other source categories as well, especially mobile sources, which account for most of the VOC emissions.

FEASIBILITY OF EMISSIONS TRADING IN THE LOWER FRASER VALLEY

The experience reviewed in this report indicates that trading of emissions reduction credits has worked in the United States. In some circumstances it has worked better than others, but there is no doubt that emissions reduction credit trading can work. Allowance trading was used to successfully lower the lead content of gasoline. A system for trading production and import permits for ozone depleting substances is currently operating in the United States. The experience gained from those programs led the United States Congress to legislate a tradeable allowance system for SO_2. That system is currently being implemented.

Economic theory indicates that emissions trading systems should enable a given air quality target to be attained at lower cost than with a conventional command-and-control approach. Analyses of the results of trading programs in the United States confirm that savings have been realized, although they may not be as large as some had hoped.

In short, emissions trading programs have proven to be feasible and to save money. However before concluding that emissions trading is feasible for the Lower Fraser Valley it is necessary to demonstrate that an emissions trading program is likely to yield savings when applied to NO_x and/or VOC emissions in the region. It is also necessary to demonstrate that a reasonably competitive market can be established in the Lower Fraser Valley so that the savings are not captured by a few large firms that dominate the market. This concern is particularly relevant because there are only seven large sources of NO_x emissions, five of which are also the only large sources of VOC emissions.

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[12] Conceptually, it is possible to define separate ozone episode allowances that reflect these restrictions that could be traded among sources, and that would be required for emissions during episodes. Given the relative infrequency of ozone episodes and the relatively small, if any, reduction from future emissions rates likely to be required, the added level of trading complexity does not appear to be justified.

These issues will be analyzed in turn. The analysis will be performed for the tradeable allowances approach and then extended to the emissions reduction credit approach.

Will Emissions Trading for NO_x and VOCs in the Lower Fraser Valley Yield Economic Benefits?

Emissions trading can yield economic savings by:

- Better matching the reductions achieved to the air quality target; and
- Allowing a wider range of compliance strategies and facilitating adoption of the lowest cost strategies.

The potential for each of these types of savings in the Lower Fraser Valley is discussed in turn.

The proven control technologies for NO_x and VOC emissions reduce emissions by larger percentages than the target reduction for the Lower Fraser Valley. With a command-and-control approach all of the affected sources would have to install one of the proven control technologies. The emissions reduction achieved would exceed the target and the control costs would therefore be higher than necessary. If only selected sources were required to install controls to better match the target reduction, the program would be unfair to those sources. An emissions trading system allows a better match between the reductions implemented and the target reduction and so reduces the compliance cost. A trading system also allows the compliance costs to be shared by all of the participating sources, not just those required to install control measures.[13]

Various NO_x and VOC control technologies are characterized in Table G-3. Most of the NO_x control technologies reduce emissions by 80% or more. Only

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[13] Sources that implement additional controls are able to sell their surplus allowances or emission reduction credits to other sources. The revenue received by the sellers helps defray the cost of the controls installed. In that sense, the buyers share the compliance costs.

Table G-3
EXPECTED REDUCTIONS FOR VARIOUS CONTROL TECHNOLOGIES

	EXPECTED EMISSIONS REDUCTION	COMMENTS
NO_x CONTROL		
Ammonia Injection (noncatalytic)	80% (Max.)	Requires oxygen to be present Limited temperature window Requires baghouse in front
Selective Catalytic Reduction (SCR)	80%	Requires baghouse in front
Nonselective Catalytic Reduction (NSCR)	85-90%	Requires large amount of reductant unless "Lean Burn" conditions exist
Electron Beam Irradiation (EBI) and similar technologies	85%	Also removes SO_2 Reactants collected in baghouse
Combustion Modifications - Low NO_x Burners, Staged Combustion, etc.	20-50%	Efficiency depends on fuel and number of methods used
VOC CONTROL		
Incineration	>99.95%	Produces halogen acids if halogen compounds are present
Carbon Adsorption	99.5%	Carbon used needs disposal. Fixed or moving carbon beds available
Condensation with "particulate" collection	0–90% Say 60% average	Depends on hydrocarbon volatility May require refrigeration system

combustion modifications have the potential to reduce emissions by approximately 40%. Clearly, an approach that mandated BACT control technology for each point source is likely to overshoot the 40% reduction target (or 50% reduction target).

The same situation applies in the case of VOC control technologies. Only condensation with "particulate" collection provides emissions reductions of less than 99% and the reductions achieved with that system depend on the hydrocarbon volatility. Again a requirement for BACT control of each point source is likely to exceed a target 40% reduction.

A tradeable allowance system for NO_x or VOCs would enable some sources to install emissions controls or to reduce their emissions by other means. Those sources will reduce their emissions by more than 40%. Yet in 2005 they will receive allowances for their base year emissions less 40% so they will have surplus allowances. Such a source can sell its surplus allowances and so recover part of the cost of the control system. A firm that did not install controls will also receive allowances in 2005 equal to its base year emissions less 40%. If it took no action and its actual emissions remained constant at the base year level, it would need to purchase allowances from other sources to be in compliance. Purchasing emissions allowances may be the lowest cost option for the firm. And purchasing allowances helps finance the cost of control at the selling source.

The second source of economic benefits available with an emissions trading system is a wider range of potential control options and a wider range of control costs. A command-and-control approach typically focuses on control technologies. With emissions trading any technique that reduces emissions can be used. VOC emissions can be cut by switching to different solvents or coating formulations. Reductions achieved by such means generate allowances that can be sold to other sources and so will be implemented if they cost less than the revenue received from the sale of the allowances. With a command and control approach there is no incentive to implement measures other than those mandated.

The costs of emissions reduction measures for NO_x and VOCs range from hundreds of dollars per tonne to tens of thousands of dollars per tonne. With such a wide range, there is a strong incentive for sources with the opportunity to implement low-cost measures to do so and to sell their surplus allowances to sources facing higher cost alternatives.[14] Both benefit from the resulting trade. The seller has earned a profit on its excess control initiatives. The buyer has reduced the cost of compliance relative to the other options available to it. There is an overall cost saving because the lowest cost reduction methods are implemented.

The above evidence suggests that emissions trading for NO_x and VOCs should produce economic benefits in the Lower Fraser Valley.

Will the Market for NO_x and VOC Allowances be Dominated by a Few Firms?

Six sources are responsible for over 60% of the point source NO_x emissions and four of those same firms are responsible for over 70% of the point source VOC emissions. Another large source of NO_x did not operate in 1985, so large sources normally account for larger shares of total NO_x emissions. To reduce point source emissions of NO_x and VOCs by 40% or more will require action by at least half of the large sources. This is true whether command-and-control or emissions trading is used. But it raises the possibility that a few large firms will dominate the market for emissions allowances if a trading system is adopted.

It is difficult to draw firm conclusions concerning the competitiveness of the market for emissions allowances before the market is created. However some guidance is available from measures of market concentration used for other purposes. More germane is the possibility of incorporating measures into the tradeable allowances program that will prevent those firms from exercising their market power.

When reviewing proposed mergers of firms in the same market, the U.S. Department of Justice is concerned about whether competition will be reduced. One of the criteria it uses to assess the impact on competition in the market is the increase in concentration due to the proposed merger. For this purpose the department uses the Herfladahl-Hirschman Index (HHI) of market concentration.

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[14] The costs of many emissions control options are source specific because they depend on the flow rate, temperature of the emissions stream, composition of the emissions stream, and other pollutants being controlled. Some comparative data on emissions control costs are found in South Coast Air Quality Management District, *Air Quality Management Plan 1991 Revision*, Appendix IV-A, Stationary Source Control Measures; Point Sources and Appendix IV-B, Stationary Source Control Measures; Area Sources, (Draft), December, 1990 and OECD, *Energy and Cleaner Air: Costs of Reducing Emissions*, Paris, 1987.

> "The HHI is calculated by summing the squares of the individual market shares of all firms included in the market.... Unlike the traditional four firm concentration ratio, the HHI reflects both the distribution of the market shares of the top four firms and the composition of the market outside the top four firms. It also gives proportionately greater weight to the market shares of the larger firms, which probably accords with their relative importance in any collusive interaction.
>
> "The Department divides the spectrum of market concentration as measured by the HHI into three regions that can broadly be characterized as unconcentrated (HHI below 1000), moderately concentrated (HHI between 1000 and 1800), and highly concentrated (HHI above 1800). An empirical study by the Department of the size dispersion of firms within markets indicates that the critical HHI thresholds at 1000 and 1800 correspond roughly to four-firm concentration ratios of 50% and 70% respectively."[15]

The four-firm concentration ratios for the NO_x and VOC allowances markets in the Lower Fraser Valley would be 53.6% and 70.2% respectively based on the 1985 inventory. The NO_x market falls into the moderately concentrated category and the VOC market is borderline highly concentrated. The fact that some of the same firms are among the largest in each market does not change the situation appreciably.

Clearly the proportion of emissions and hence allowances among the largest firms is such that concern over possible noncompetitive behaviour is valid, but the concentration is not so high as to be alarming. Smaller sources will need smaller quantities of allowances if they are buyers, and these can be supplied by other small sources. Hence the small sources are not captive buyers or sellers for the large sources.

The allowance trading program can be designed to minimize the potential for noncompetitive behaviour by large sources. The SO_2 allowance trading program in the United States includes such provisions. Specifically, it withholds a small fraction (2.8%) of the allowances allocated to each source and sells those allowances by auction with the proceeds being distributed to the sources from which the allowances were withheld. In effect every source is forced to become a seller of a small fraction of its allowances. In addition there is a reserve from which the government can sell allowances if the market price rises too high. In our judgment allowance trading programs with provisions of this sort are feasible for the Lower Fraser Valley.

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[15] Antitrust Division, *U.S. Department of Justice Merger Guidelines,* U.S. Department of Justice, Washington, D.C., June 14, 1984, pp. 13–14.

Emission Reduction Credit Programs

An emission reduction credit trading program is intended primarily to facilitate economic growth in the region while protecting air quality. The improvements in air quality are achieved primarily through command-and-control measures. The netting provisions reduce the costs of compliance with the regulations to improve air quality for existing sources. The offset provisions allow new sources and expansion of existing sources in the region without a deterioration of air quality. In short some economic benefits are realized with an emissions reduction credit program, but they are not as large, and are not intended to be as large, as with an allowance trading program.

With an emissions reduction credit program, the buyers are new or modified sources whose emissions exceed the threshold level. We have argued for low (zero) thresholds which would increase the number of buyers. Any existing source can, in principle, create emissions reduction credits and become a seller. Opt-in provisions offer the potential to increase the number of sellers. Lack of competition has not been a problem in any of the American jurisdictions studied even when the number of trades has been small.

Emissions Trading Is Feasible in the Lower Fraser Valley

We conclude that either an emissions reduction credit or an allowance trading system is feasible for both NO_x and VOCs in the Lower Fraser Valley. If an allowance trading system is adopted, it should include provisions to ensure that a competitive market for allowances is maintained. The emissions reduction credit system is one that relies primarily on traditional command-and-control approach to achieve the air quality improvements. Trading is a means of facilitating compliance by larger sources and for accommodating economic growth.

Allowance trading is a more radical change; it substitutes trading for command and control prescriptions as the primary means of achieving the air quality improvements. It does not preclude additional command-and-control measures, but the more restrictive those measures are the lower the benefits of the trading program.

IMPLEMENTATION RECOMMENDATIONS

If emissions trading is implemented in the Lower Fraser Valley for NO_x and/or VOCs (or other pollutants) we recommend that the GVRD and the Ministry of Environment:

- Define the goals of the program clearly. With clear goals, it is easier to design the program well and to evaluate its performance subsequently. The GVRD and the NO_x/VOC Management Plan appear to agree that ozone concentrations in the region should not exceed the Maximum Acceptable Level and that substantial reductions of NO_x and VOC emissions will be needed to reach that objective. Although they may not agree on the specific reductions achieved, that need not delay adoption of an emissions trading system. The trading program can be designed to achieve specific interim targets, which can be revised as better research or the ultimate reductions that need to be achieved becomes available.

- Base the program on a quality emissions inventory. An inventory that covers all point sources in the Lower Fraser Valley is about to be prepared for 1990. Every effort should be made to ensure that it is accurate. If it is to be used as the basis for a trading program, point sources should have an opportunity to verify their emissions. The apparent discrepancy between the federal and GVRD emission inventories for the Lower Fraser Valley should not delay adoption of an emissions trading program. The trading program can be based on the GVRD's 1985 or 1990 inventory modified by other data if appropriate.

- Review its permit system to ensure that it meets the needs of the trading program. All point sources within the GVRD already require permits. Point sources in other parts of the Lower Fraser

Valley require permits from the Ministry of Environment. However, the reporting requirements or other provisions may need to be modified to support the trading program.

- Bring emissions trading and air quality in the Lower Fraser Valley under the control of a single administration. The majority of point sources are located within the GVRD, however air quality administration and emissions trading should treat the Lower Fraser Valley as a single region. This can be achieved by having the GVRD and the Ministry establish identical requirements for the Lower Fraser Valley and by allowing trades across jurisdictions. Or air quality management in the Lower Fraser Valley could be embodied in a single administration, for example, by delegating air quality management responsibility for the rest of the region to the GVRD.

- Ensure that emissions trading has the support of stakeholders and the public. Explain the program and the reasons for its adoption to stakeholders and to the public.